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MEANS OF PLANT DISPERSION.[1]

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THE paper which is embraced in the following pages can hardly be called one on a subject of microscopy, though to establish some of its facts it requires the aid of the microscope. But the great interest now taken in all biological studies, leads us to look and work beyond the field of view bounded by objectives. They are instruments to help the eye, and are mainly useful when the unaided eye fails to see distinctly. Hence the choice of a subject having a wider range than those ordinarily treated here. The facts presented are mostly those that have come under my own observation, based on an experience of several years of work in field and cabinet, and may be easily verified by any one so disposed, even if not already familiar. They are chiefly confined to our own flora, that the paper may have a local interest, although many instructive illustrations might be cited from the writings of others. They are also limited to the propagation of plants by means of fruit, seed and spore, or analogous substitutes for these, and to their adaptations and the agents that act upon them to accomplish this result. The agency of man is excluded except in so far as it may be unintentional, or merely accidental, as in the case of any animal. It is to the means of dissemination found in nature, of which the plant may avail itself, that the subject will be restricted.

It is one that has to some extent received attention from botanists, though in the main incidentally. Near the close of the last

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century Joseph Gaertner published his great carpological work, "De Fructibus et Seminibus Plantarum," in which the fruits and seeds of more than a thousand species of plants were described and figured, and among them many curious contrivances, but without specifying their use to the plant. It became a classical work on morphology, and had its influence on the natural classification of plants. A. P. DeCandolle, in his work, "Physiologie végétale," and Alphonse DeCandolle, in his "Géographie botanique raisonée," paid considerable attention to this subject, and have recorded observations of much interest. Among the Germans may be named Naegeli and Kerner, and of Italians, Delpino, as students of these phenomena. They did not escape the notice of so careful an observer as Darwin. But the stimulus of his writings has had a greater effect in directing the mind to them than any extended observations of his own. The best and most complete treatise we have seen, is that of Dr. Friedrich Hildebrand, of Freiburg, "Die Verbreitungsmittel der Pflanzen, Leipzig, 1873."[1] In this small volume of one hundred and sixty pages he brings together a great number of interesting facts, systematically arranged, and accompanies them with several illustrative figures. Since, as already stated, the plan of this paper mainly contemplates those facts that have come under my own observation, his work will be used only in a most general way. There is enough in our flora to illustrate all the most important characteristics of fruits and seeds, and the contrivances and agencies for their dispersion and propagation as noticed by him, so that there is no need of resorting to the flora of the world to find them.

The subject is naturally divided into four parts, both as to adaptations of structure and agents for distribution. The agents are the wind, water and animals, for each of which are found contrivances suited to these modes of spreading. There is a fourth class, dependent on special movements in the plant itself. Each of these topics will be considered in order.

I. In examining plants with reference to modes of distribution, the agency of the wind is the most obvious and universal. The means to secure this result are quite various in kind, and are mostly comprised in two divisions, adaptations of fruit and adaptations of seed.

[1] To this I am indebted for some of the facts of this paragraph, as well as to Sach's Geschichte der Botanik, München, 1875.

In contrivances for scattering fruits or seeds by wind agency, it is plain that their mass must be relatively small and light, or if large or heavy the buoyant part must predominate. The problem is to overcome the lightness of the air by a substance specifically heavier, which may, however, by the aid of currents of air acting on some equipment, be wafted away from the parent stock. The germ of a new plant may in this way be taken up and carried a few feet or yards, or even many miles. The modifications of fruit to secure this end will be noticed first, some of the most common examples being taken for illustration.

The samara, or key-fruit of the maple, is a familiar case. When the key is double, as in the common maples and Negundo, each part has a striking resemblance to the wing of an insect, being thicker and narrower at the base, thinner and broader at the top. In the ash the wing has a spatulate form; in the elm and birch it is oval, the wing encircling the fruit. In the hop tree (*Ptelea trifoliata*) it is similar, being almost circular. A contrivance much like a samara is found in Liriodendron, the tulip tree. The numerous pistils of a single flower are attached to a common axis, making a cone-shaped collection as a whole. Each carpel is furnished with a wing, pointing upward along the axis, and as they fall away separately they may be taken and borne off by the wind. If the fall of the samara, or key-fruit of the maple or ash be watched, the usefulness of this appendage is easily discerned. It falls with a whirling motion, like a stone with a shingle tied to it, and may be carried to quite a distance even by a slight breeze, and much farther if the wind be high.

Smaller but similar growths from the fruit are found in some of the Umbelliferæ, as in the carrot, parsnip, cow parsnip (*Heracleum lanatum*), Polytænia, Archemora and Archangelica. In these the achenia are more or less winged, as may be seen in the so-called seeds of the carrot and parsnip of the shops.

Here also must be placed that adaptation for dispersion seen in the common basswood (Tilia), a bract growing from the peduncle. In form like the wing of a samara, it serves to carry the nuts attached to the lower end of the stem and its branches, away from the parent tree, and its gyrations while doing so are rather peculiar and complicated. In the hop hornbeam (*Ostrya virginica*) and the blue beech (*Carpinus americanus*), the enlarged bracts of the involucre, becoming dry when the fruit ripens, serve to bear

away the masses of fruit they enclose. And the large membranaceous and inflated pod of the bladder-nut (*Staphylea trifolia*), a common shrub in rich open woods, is a kind of natural balloon, readily made the sport of the wind.

As attachments to the end of fruits some good examples are found in the Ranunculus family, in the tailed fruits of Clematis and *Anemone patens.* The autumnal beauty of the virgin's bower (*Clematis virginiana*) when these white plumes are fully formed, quite equals that of its profusion of white blossoms in the summer, and exceeds it in interest. Beauty and utility are here combined in the plan for dispersion by the wind. And one hardly knows which to admire most, the broad purple eye of the pasque flower (*Anemone patens*) dotting the prairies and hillsides of the North in early spring, or its head of fruit, white with feathery tails, seen at a later day. Some of the humbler anemones, such as *A. caroliniana, cylindrica* and *virginiana,* with fruit thickly clothed in matted wool, are well provided with means of dispersion by wind agency.

But the best contrivance for this mode of spreading is the downy or feathery attachment to fruits, called pappus. Morphologically it is a modified calyx; this, adhering to the ovary, rises above it in a tuft of hairs or some kindred form in the place of sepals. Its prevalence in the numerous genera of the great order Compositæ is a marked characteristic of these plants. In some, as Aster, Solidago, Erigeron, Vernonia, it is so short as not to be very efficient for conveyance to any distance, though it furnishes considerable aid, and must not be passed by as unimportant. Its most remarkable development is in the dandelion, thistle, fire-weed (*Erechthites*), Lactuca and Sonchus. Generally it consists of a copious tuft of hairs attached to the top of the achenium, and radiating so as to form a spheric or hemispheric mass. Sometimes, as in the dandelion, the calyx tube is prolonged into a stipe when the fruit matures. This, dividing and spreading at the top, makes a globular head of hairs. That a downy head like this serves its purpose well will be affirmed by all who, on a windy day, have seen the air in the vicinity of a luxuriant growth of thistles filled with their light forms of fruit speeding away to distant fields. Far as the eye can discern them they may be seen, each with its tiny freight of fruit. Rivers and lakes, forests, hills and mountains do not offer an insurmountable barrier to their

course, since they are able to pass over them. The way in which the scales of the floral involucre open, facilitates the process. When green they are more or less closely appressed to the head of flowers; when ripe they become dry and spread in a horizontal plane, or become reflexed. This exposes the fruit to the ready access of the wind, and it is easily lifted from its seat on the receptacle.

In the valerians, two species of which are found in our limits, *Valeriana edulis* and *V. sylvatica*, a modified calyx also serves this purpose. Being persistent and coherent with the one-celled and one-seeded ovary, its limb divides into several plumose bristles, much like a pappus; these, rolled inward in the flowers, unroll and spread as the fruit matures.

Among the endogens are found a few of these equipments. In Typha, the common cat-tail rush, the ovaries are surrounded with bristles, making the abundant down of the fruit, and adapting it to wind dissemination.

In the sedge family are some examples of fruit adjusted to this end, principally in Eriophorum, or cotton-grass, and in two species of Scirpus, *S. lineatus* and *S. eriophorum*. Three species of Eriophorum are common about Lake Michigan (*E. virginicum*, *E. polystachyon* and *E. gracile*) in marshes and wet prairies, and may easily be detected among the surrounding plants in summer and early autumn by their cottony heads. The bristles which form the perianth, generally short in other genera and species of this family, lengthen greatly in the cotton-grass, in some cases to an inch, becoming enlarged and numerous. The construction in Scirpus is similar but not so marked.

The beards and awns of grasses will, to some extent, serve the same purpose. Such as have them possess an instrument for catching the wind, and the grain is likely to be more effectually scattered than in the case of those devoid of them. The common reed (*Phragmites communis*) has the rachis of the spikelets of its ample panicle prominently bearded with soft hairs just below the spikelets, which are easily detached when ripe. The whole appearance is like a plume, and either as a whole or in parts is a light object that may be blown about by the wind. In Calamagrostis and Erianthus, there is an analogous arrangement. The spikes of *Hordeum jubatum*, or squirrel tail grass, of Setaria, Gymnostichum and Andropogon are also aided by their hairs

and awns. The grain of Stipa is scattered around the plant by the wind, the long awn, aiding in this as well as in directing it, point downward, like a dart to the earth, and pushes the backwardly roughened point into the sand, the grain boring its way in as the awn twists and untwists according to varying conditions of moisture.

Seeds also possess contrivances for dispersion analogous to those already described for fruits. There are seeds with wings, with tufts of hairs at the end, with cottony fibers imbedding them.

Some of the best examples of winged seeds are found in the Coniferæ, particularly the pine and fir. The seeds of these, either singly or in twos, are attached to the inner sides of the scales of the cones, which, when ripe, open so that the seeds may easily fall out or be detached by the wind. The Bignonia family has good representatives of this mode. When the pod of the catalpa opens, winged seeds are found, the wings being cut into a fringe. *Bignonia capreolata* and *Tecoma radicans*, the latter common in cultivation as the trumpet-creeper, are also provided with winged seeds. In some of the smaller plants, as in species of Arabis (*A. lævigata* and *A. canadensis*) the little seeds have a broad wing that materially helps their dispersion when the pod dehisces.

The analogues of fruit with pappus are seeds with a coma, or tuft of hairs. Some of the best illustrations are those of Asclepias and Apocynum. The silky down of the seeds of the silkweed, or milk-weed (Asclepias) forms as efficient a means of spreading by wind agency as the hairs of the thistle or dandelion. The hairs are fully developed as soon as the pod is ripe and ready to open, and are so closely packed that on its opening they bulge out in a fluffy mass like those in the boll of the cotton plant, also a good example of a similar provision. The seeds of Asclepias are also very flat and margined, so as to come under the head of those furnished with a wing, being thus doubly provided with wind adaptations. The willow-herbs (Epilobium) also have seeds with a tuft of hair at the end. The most common and showy of these, *Epilobium angustifolium*, often called fire-weed from its habit of springing up from ground recently burnt over by fire, is thus able to spread with rapidity, like its congener, *Erechthites hieracifolia*, of the Compositæ, also called fire-weed from the same habit.

In the willows and poplars the seed is enveloped in cottony fibers, as in the cotton plant, rendering it very buoyant. The air around a cottonwood tree (*Populus monilifera*) is well filled with these whitened objects, like little bunches of cotton, on a windy day in spring or early summer, when the pods open, thus verifying its popular name.

In scattering the spores of cryptogams currents of air act in a most effectual manner. The spores of the vascular cryptogams, and of mosses, lichens and fungi, as fine as dust, can be carried by the winds as readily as dust, and lodged in any soil suitable for growth. In this respect they are like the pollen of wind-fertilized flowers. Since many of these plants are parasites, and injurious to animal and vegetable life, as well as beneficial in some cases in keeping in check forms even more destructive, their mode of diffusion offers a field of investigation of the greatest practical importance. If the germ theory of disease be true, the physician can find in the air one of the most efficient instruments for spreading disease.

Many small seeds that have no special contrivance to secure their dispersion are blown away from the parent plant. Their intrinsic lightness is an adequate adaptation, as in the case of spores. The only peculiarity may be in the pod itself, in its mode of dehiscence, or way of exposing the seed. It may open so that the wind has free access to the seed; or the seed may be caught in the act of falling and turned from its course. In the mustard family the valves of the pods sometimes, as in Arabis, loosen at the base and turn upward, thus exposing the seeds as they hang in the partition between the valves. A loculicidal dehiscence or splitting of the wall of a capsule so as to open directly into a cell, favors this result. In the pink family the pod splits up into several parts, often ten, effectually exposing the small seeds. As seeds thus to be dispersed by wind agency, may be mentioned those of figworts (Scrofulariaceæ), primroses (Primulaceæ), poppies (Papaveraceæ) and gentians (Gentianaceæ), a list that might be much extended.

Nor should we limit the power of the wind in spreading fruits and seeds to the lighter kinds, for it has an important effect on the larger and heavier. As they mostly ripen at the time of the year when the winds are usually strongest and often shifting in direction, nuts and heavy fruits are blown to a considerable distance

around the tree on which they grow. They do not fall vertically as when the air is still, but are deflected from this course. All who remember their childhood experience in gathering nuts, will confirm this. They were not all found beneath the particular tree that bore them. In this way the heaviest of the forest fruits, like those of the butternut, walnut, hickory, chestnut, beech and oak, are quite extensively scattered.

Plants are also blown about as a whole or in bulk, or their fruiting branches are thus blown. This is not uncommon with grasses having capillary panicles. In this way species of Panicum (witch-grass) and Eragrostis are sent whirling over the fields in autumn, and are often seen piled against a fence, or the windward side of any obstacle by which they have been stopped. The same is also true of many other plants. Some of our common weeds are dispersed in this way. One example is in point. I have often watched with interest the movements of a weed abundant in gardens and cultivated fields, *Amarantus albus.* It is rightly named in some localities the *tumble-weed.* The diameter of a well-grown specimen is rather more than its height, the stems spreading in all directions from the short tap root. Soon turning upward at the ends, they make a bushy weed of a roundish form. When ripe and dry the constant tugging of the wind tears it from the soil and sends it rolling and bounding across the fields, much like a hat blown from the head. This constant jarring threshes out the seed that may have resisted gentler treatment, and sows it broadcast over the fields to annoy the farmer the coming year. They are sometimes piled fence high in some of the large fields of prairie farms, to be blown away again in the opposite direction when the wind changes and dislodges them from their place of temporary rest.

II. The second group of adaptations depends for its efficiency on the agency of water. The limits of this paper will not permit the enumeration of the various plants that may, in different degrees, be aided in this way. If the germ is sufficiently protected from injury while in the water, from germination or destruction before reaching a place suitable for growth, this means of transfer may be available in a large number of cases. It is evident that islands have in this manner, and by the aid of winds and animals, often or even mainly obtained their species of plants, usually like those of adjacent shores. The similarity of their

flora to that of the mainland near by is a proof of this, since many of their plants could have been received in no other way, unless the islands have been at some former era physically joined to the continents, and afterward cut off by water through subsidence. Hard fruits like walnuts, butternuts and acorns readily bear this transportation, and their thickened coats serve not only to keep the water from injuring the germ, but also help to float them by rendering them lighter in proportion to the water displaced. So too with hard seeds that may be dropped into the water by plants which grow along its margin. In this way streams, and currents on ponds, lakes and arms of the sea, aided by winds that drift bodies along the surface of the water, bear their freight of seeds and fruits from land-grown plants.

But aquatic plants, whose fruits and seeds ultimately sink in water, must be principally dispersed in this manner. They generally grow in the stiller parts of streams and sheltered places of ponds and lakes, and their seeds are borne away by currents or drifted by winds till lodged or dropped in quiet spots. Sometimes there are special equipments to facilitate this, like wings or other floats, such as are also suitable for wind transportation. A good example of this is the fruit of the common arrow-head (Sagittaria), which, surrounded by a wing, easily floats away on the water. The flattened spikelets of aquatic grasses, like Leersia, and the inflated perigynea of many sedges of the genus Carex, as well as the bristles that surround the fruit of some, like Eleocharis, contribute to this result. It is a common thing to see plants floated off wholly or in part by water. The current of any stream shows this. The shores of ponds and lakes, and the banks of rivers are often strewn with species of the plants that grow in them. By their examination the collector learns what may be found in them even before seeking for their particular location. If torn from their place of growth at the time of ripened fruit, this becomes an effectual means of propagation. Stems of Potamogeton and other Naidaceæ, of Myriophyllum and Ceratophyllum, carry their seed in this way. This is especially true of some plants that are rootless and float naturally on the surface, like the Utriculariæ, or bladder-worts, some of which are provided with bladders to sustain them on the water. The duckweed (Lemna) and Wolffiia are in this manner carried everywhere in the waters they frequent, till they find some quiet place where they can mul-

tiply and propagate themselves. The same is true of the great family of Algæ. As the air is the natural medium for scattering the spores of terrestrial cryptogams, so the water is for the spores of aquatic cryptogams. In some the spores are furnished with a vibratile filament, a tail-like appendage that moves them about like analogous organs in the flagellate Infusoria. Desmids and Diatoms are found in all our waters, the sport of the waves and currents. And as the majority of the Algæ are unattached, floating plants, they will be transported wholly or in part to all parts of the medium they inhabit.

(To be continued.)

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ON THE CLASSIFICATION OF THE LINNÆAN ORDERS OF ORTHOPTERA AND NEUROPTERA.

BY A. S. PACKARD, JR.

IN the forthcoming third report of the U. S. Entomological Commission, we have endeavored to ascertain the position of the Orthoptera in reference to allied ametabolous insects. The following pages are extracted from the chapter, with some omissions:

We have examined the fundamental characters of the head, thorax and abdomen, points neglected by most systematic writers, not spending much time on the peripheral, *i. e.*, the superficial adaptive characters of the mouth-parts, wings and legs, which have been elaborated by systematic entomologists; believing that by this method perhaps more thorough and better grounded views might result. The outcome has been to lead us to separate the Neuroptera, as defined farther on, from the Pseudoneuroptera, and to regard these two groups, with the Orthoptera and Dermatoptera, as four orders of a category which may be regarded as a superorder, for which the name Phyloptera is proposed, as these four orders are probably closely allied to, if not in some cases identical with, the stem or ancestral groups from which probably all the higher orders—the Hemiptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera—have originated.

We will first briefly summarize the characters, as we understand them, of the Phyloptera as a whole; then the distinguishing marks of the four orders.

Superorder PHYLOPTERA.[1]

The mouth-parts are free, adapted invariably for biting; the mandibles being toothed and adapted for chewing; the first maxillæ separate, with three divisions, the outer bearing usually five-jointed palpi; the second maxillæ united to form a labium divided into a submentum, mentum and ligula, the latter varying much, being either cleft (Pseudoneuroptera) or entire (Neuroptera), and bearing usually a three-jointed palpus. This is the primitive, elementary condition of the mouth-parts, and such as obtains in Coleopterous larvæ. The head is notable from the great development of the epicranium. The clypeus is often divided into two portions, a posterior (post-clypeus) and anterior (ante-clypeus); in the other and higher orders the clypeus is entire.

The prothorax is usually very large and square, but in a few families, as the Phryganeidæ, Panorpidæ, Psocidæ, Libellulidæ and Ephemeridæ, it is small and collar-like. There is a marked equality in size and form of the meso- and metathorax; in most Orthoptera and some Pseudoneuroptera and Neuroptera, the metathorax is often even larger than the mesothorax; in this respect the Phyloptera differ from any of the higher Hexapoda. In both of the two hinder segments of the thorax the four tergal sclerites, viz: the præscutum, scutum, scutellum and postscutellum, are each well developed, and more equably so than in any other order. The scutum is deeply excavated in front to receive the often large subtriangular or cordate præscutum; and in some genera the scutum is, so to speak, cleft in two by the meeting of the præscutum and scutellum in the median line. The flanks of the thorax, or pleurites, are often very large, and the episternum and epimerum are broad, oblong, or squarish, and these sclerites are sometimes subdivided into an upper and lower division (supra and infra epimerum or episternum). The sternum is often large, flat and broad; it is sometimes divided into a sternum and præsternum.

The wings are usually net-veined, often with numerous longitudinal veins, the branches of the subcostal, median and submedian veins being either very long, and parallel with the longitudinal axis of the wing, or numerous and small (especially in the hind wings of Orthoptera).

[1] From φῦλον, gens, nation; πτερον, wing.

The hind wings are often (Orthoptera and Odonata) broader and larger than the anterior pair, the metathorax in such cases being a little larger than the mesothorax.

The abdomen has in this group, including representatives of the Neuroptera, Orthoptera, Dermatoptera and Pseudoneuroptera, besides a tenth nearly-complete segment, the rudiments of an eleventh uromere, represented by a tergite forming the supra-anal triangular plate. Well developed jointed cercopoda occur in the Orthoptera and Pseudoneuroptera, while the forceps of Forficula (Dermatoptera) are undoubtedly modified cercopoda. An ovipositor occurs in the Neuroptera (Panorpidæ) and Orthoptera.

The metamorphosis is incomplete in all the orders of Phyloptera except the more recent and higher order, *i. e.*, the Neuroptera (in Erichson's sense), in which the transformations are complete, the pupa being quiescent and wholly unlike the larva.

The relative standing of the four orders of Phyloptera is shown in the table or genealogical tree of the winged insects on page 829.

The sequence of the orders, such as we are compelled to adopt in writing or speaking of them, is difficult to decide upon. Beginning with what on the whole may be regarded as the lowest order, we might first take up the Dermatoptera, which are, in most respects, the most generalized forms, and stand nearest to the Thysanura (Japyx).

The following is the succession of orders, placing the lowest uppermost:

Dermatoptera Burm.
Orthoptera Linn.
Pseudoneuroptera Erichson.
Neuroptera Linn., restricted by Erichson.

Before discussing the relative standing of these orders, we will briefly indicate the more salient and generally applicable differential characters, especially what we regard as the more fundamental ones, but slightly touching upon the mouth-parts and wings, these being peripheral and more adaptive characters, and liable to greatest variation, and being of less value in characterizing the orders of Phyloptera.

Order 1. Dermatoptera.

Forficula presents so many features separating it from the Orthoptera, and is so composite a form that it should be regarded

as the type of a distinct order, in which it was originally placed by Leach, Kirby, Burmeister and Westwood. Its composite nature is seen both in the elytra and the hind wings, which anticipate the Coleopterous type of wings. On the other hand the larvæ resemble Japyx, the Thysanuran, with its anal forceps, and in most respects Forficula is the lowest, most decided stem-form of the Phyloptera.

The Dermatoptera are characterized by the flatness of the body and the large terminal forceps. The head is flat, horizontal in position, while the presence of the V-shaped epicranial suture is a sign of inferiority, as it is characteristic of Thysanura and Platypteran larvæ as well as Coleopterous larvæ. The remarkable thoracic structure, which is described farther on, as well as the curious overlapping of the abdominal tergites, forbid our uniting the Dermatoptera with the Orthoptera. The small, short elytra and the very large, rounded, longitudinally and once-cross-folded hind wings, which remind us rather of the Coleoptera than Orthoptera, are also important diagnostic features. Finally, the metamorphosis of the Dermatoptera is even less complete than that of the Orthoptera.

The ligula is bifid, being divided into a pair of two-jointed paraglossæ. The labium is thus similar to that of the Orthoptera, though scarcely more like them than like Termes.

Order 2. Orthoptera.

The head is more or less vertical in position; the front is very large, broad and long, the epicranial region very large and often hypertrophied. The clypeus is large and subdivided as in Pseudoneuroptera. In the Orthoptera, as a rule, the deeply-cleft ligula is indistinctly four-lobed, the outer pair of paraglossæ very well developed, while the inner pair is minute or undeveloped, as in the Acrydii, especially Caloptenus; but in the Locustariæ the ligula is four-lobed, and in the Gryllidæ decidedly so. In the Mantidæ and Blattariæ the ligula is plainly four-lobed, nearly as much so as in the Termitidæ. In the Phasmidæ the ligula is intermediate in form between the Mantidæ and Locustariæ.

The prothorax is usually remarkably large, particularly the notum. The meso- and metanotum exactly repeat each other, and the metanotum is usually (Acrydii and Locustariæ) longer and larger than the mesonotum, the hind wings being almost uniformly much larger than the anterior pair. The pleurites are

very large and square as well as high, the episterna and epimera being large and oblong and equally developed. The sternites are very large and broad. The coxæ are sometimes (Blatta) very large; the hind legs in the Acrydii are much larger than the anterior pairs. The fore wings are narrower than the hinder pair, and show a slight tendency to become subelytriform; on the other hand the hind wings are very large and broad, distinctly net-veined, with numerous longitudinal veins, and they fold up longitudinally.

The abdomen has eleven uromeres, the eleventh forming a triangular tergite. The cercopoda are often (Blatta, Mantis, &c.) multiarticulate and well developed, while the ovipositor is often large and perfect. The metamorphosis is more incomplete than in the Pseudoneuroptera.

With the exclusion of the Forficulariæ, the Orthoptera, as here restricted, are a tolerably well circumscribed group; and though there are great structural differences between the families, yet the connection or sequence of the families from the Blattariæ through the Phasmidæ and Mantidæ and Acrydii to the Locustariæ, and finally the highest family, the Gryllidæ, is one which can be distinctly perceived. There is no occasion for a subdivision of the order into groups higher than families, as the Blattariæ are but a family removed from the Mantidæ.

Order 3. Pseudoneuroptera Erichson.

It is difficult, if not impossible, to satisfactorily characterize by a sharp-cut definition this very elastic order. As regards the thorax, there is no uniformity in the structure that we have been able to discover, nor is there in the structure of the wings, nor more than a general resemblance in the mouth-parts.

The definition of the Pseudoneuroptera in Hagen's Synopsis of the Neuroptera of North America, as given in the analytical table, which is stated in a foot-note to have been prepared at the request of the Smithsonian Institution by Baron Osten Sacken, gives no fundamental characters based on a study of the trunk. Those mentioned are what we have called peripheral characters, *i. e.*, those drawn from the mouth-parts, wings and appendages. So far as we know, no satisfactory definition of the Pseudoneuroptera has ever been given. In Hagen's Synopsis, among the other superficial characters given, are these: "Lower lip mostly cleft;" "antennæ either subulate and thin, the tarsi three to five-

articulate, or setiform or filiform, in which case the tarsi are two to four articulate." These characters, though superficial, are the most important yet presented, perhaps (disregarding the metamorphosis), for separating the Pseudoneuroptera from the genuine Neuroptera. But the cleft labium is also to be found in Orthoptera; and among the Orthoptera, which usually have five-jointed tarsi, the Mantidæ have four tarsal joints. The Perlidæ, Odonata and Ephemerina have been, by Gerstäcker (Peters and Carus' Zoologie), associated with the Orthoptera under the name *Orthoptera amphibiotica*, but such an alliance does not seem to us to be entirely a natural or convenient one; it is simply transferring a mass of heterogeneous forms to what, as now limited, is a natural and well circumscribed category, and yet we confess that it is difficult to give diagnostic adult characters separating the Pseudoneuroptera from the Orthoptera, though the general facies of the Orthoptera is quite unlike that of the Pseudoneuroptera.

In the Pseudoneuroptera, beginning with the more generalized forms, the Perlidæ and Termitidæ, the labium (second maxillæ) is deeply cleft, the cleft not, however, in these or any other insects, extending to the mentum, or even clear through the palpiger. Each lobe is also cleft, so that the ligula is really four-lobed; the outer lobes are called by Gerstäcker[1] the "lamina externa," and the inner the "lamina interna." These finger-shaped, non-articulated fleshy lobes appear to be homologous with, or at least suggest the outer pair of, paraglossæ of the Coleoptera and Hymenoptera. In the Perlidæ the four lobes of the ligula are well developed, and the lobes of the inner pair are broader than the outer. In the Termitidæ the lobes are well developed, but the inner pair of lobes is either one-half or not quite so wide as the outer paraglossæ; the palpiger is cleft. In the Embidæ, according to Savigny's figures, the ligula is four-lobed, but the inner pair is narrow and rudimentary.

In the Odonata, according to Gerstäcker's excellent drawings, the ligula varies much. In Gomphus it is entire; in some of the higher Libellulinæ only two-lobed; but in Æschna it is four-lobed, the outer lobe slender, but separate from the palpus. In Calopteryx the ligula is widely cleft, the two inner lobes are wide apart, while the outer pair is consolidated with the labial palpi.

[1] Zur Morphologie der *Orthoptera amphibiotica*. Aus der Festschrift zur Gesellsch. Naturforsch. Freunde, 1873.

Owing to the specialized nature of the labial palpi, the mouth-parts of the Odonata are sufficiently *sui generis* and distinctive to prevent their being placed among the Orthoptera, even if the thorax were not so dissimilar. In the aborted labium and other mouth-parts of the Ephemerina we also have strongly-marked characteristics forbidding their being placed in the Orthoptera; were it not for the strong resemblance of the Termitidæ to the Orthoptera (Blattariæ) probably no one would have thought of carrying the Pseudoneuroptera over into the Orthoptera.

The relative proportion of the head and sclerites varies greatly; no general rule can be laid down as to the relative proportions of the epicranium and of the clypeus, or of the gular region.

On this account I had at one time decided to split the group into two, and to restrict Erichson's Pseudoneuroptera to the Platyptera,[1] and to adopt Latreille's term Subulicornia for the Odonata and Ephemerina (Subulicornes of Latreille). It may, however be best for the sake of clearness to retain Erichson's order Pseudoneuroptera as he indicated it, and to dismember it into what may be regarded, provisionally at least, as three suborders:

1. *Platyptera* (Termitidæ, Embidæ, Psocidæ and Perlidæ = Corrodentia and *Orthoptera amphibiotica* in part).
2. *Odonata* (Libellulidæ).
3. *Ephemerina* (Ephemeridæ).

It is comparatively easy to give well-grounded differential characters for these three suborders. They are so distinct that they may perhaps hereafter be regarded as entitled to the rank of orders, or the Pseudoneuroptera may be dismembered into the Pseudoneuroptera and Subulicornia (Odonata and Ephemerina).

1. *Platyptera.*—The body is flattened; the head horizontal. The pronotum is large, broad and square. The meso- and metanotum are remarkable on account of the imperfect differentiation of the scutum and scutellum; the latter is indefinite in outline, but very large. The flanks (pleurites) are, when long, oblique, or are short. The sternites are usually very large and broad. There are often eleven uromeres.

2. *Odonata.*—While the Odonata and Ephemerina are somewhat alike as regards the form and venation of the fore wings, in their mouth-parts and thorax they are entirely unlike. The

[1] This name πλατύς, flat, πτερόν, wing, in allusion to the wings which in the majority (the Psocidæ folding their wings rather roof-like) fold their wings flat on the back. The Isoptera of Brullé comprise the Termitidæ.

Odonata are remarkable for the great dorsal (tergal) development of the mesepisterna and the enormous development of the meso- and metapleurites in general, while the notum of meso- and metathorax, though of the same type as the Orthoptera, is minute in size. The prothorax is very small, both dorsally and on the sides forming a collar.

The wings are as markedly net-veined as in the Orthoptera, though the hinder pair are not folded longitudinally as in that order. The Odonata literally live on the wing, and thus the shape of the sclerites of the notum of the wing-bearing segments approaches that of the Orthoptera, although the prothorax is remarkably small compared with that of the Orthoptera, and forbids their union with this order, as was done by Gerstäcker and other German entomologists. The head of the Odonata is remarkable for the enormous size of the eyes and the consequent great reduction in size of the epicranium as compared with the large epicranium of the Orthoptera. The mouth-parts are like those of the Orthoptera except that the second maxillæ form a remarkable, mask-like labium. The abdomen is very long, slender and cylindrical; there are eleven uromeres, the eleventh being well represented, while the cercopoda are not jointed but in the form of claspers.

3. *Ephemerina.*—In the small epicranium and the large male eyes the Ephemerina resemble the Odonata, though the rudimentary mouth-parts are in plan entirely unlike them. So also the prothorax is small and annular, but the subspherical, concentrated thorax is remarkable for the large mesothorax and the small metathorax. Hence, the hind wings are small and sometimes obsolete. The long, slender abdomen has ten uromeres, and bears, besides the two long filamental multiarticulate cercopoda, a third median one.

The larvæ of the lower Odonata and of the Ephemeridæ closely approach in form those of the Perlidæ, showing that the three suborders here mentioned probably had a common ancestry, which can be theoretically traced to a form not remote from Campodea. By reason of the general resemblance of the larval forms of these three suborders it would be inadvisable to separate the Odonata and Ephemerina from the Platyptera, although when we consider the adult forms alone, there would appear to be some grounds for such a division.

Order 4. NEUROPTERA.

The head is horizontal and somewhat flattened, except in the Trichoptera and Panorpidæ, where it is subspherical and vertical. The body shows a tendency to be round or cylindrical, the thorax being more or less spherical, but there is great diversity in form from the Sialidæ to the Trichoptera. The mouth-parts are free and the mandibles well developed, except in the Trichoptera, where the mandibles are nearly obsolete in form, and functionless, thus suggesting or anticipating the Lepidoptera.

In the Neuroptera the ligula is entirely unlike any of the foregoing and lower groups. It is entire, forming a broad, flat, large, rounded lobe; it is largest in Myrmeleon, Ascalaphus and Mantispa, but smaller in Corydalis, where it is also narrower and indented on the front edge.

In Panorpa the ligula is minute, rudimentary. In the Trichoptera it is also minute and rudimentary.

The prothorax is usually (Planipennia) large, broad and square, but is ring or collar-like in the Trichoptera, being short and small, much as in Lepidoptera. Except in the Trichoptera, the meso- and metanotum are characterized by the large, cordate præscutum, and in the Hemerobina the metascutum is partially or (in Ascalaphus) wholly cleft, the præscutum and scutellum meeting on the median line of the thorax.

In the Hemerobina and Sialidæ the metathorax is as large, or nearly as large, as the mesothorax, and the hind wings are as large as the anterior pair. The wings are not net-veined, the type of venation being entirely unlike that of the Orthoptera and Pseudoneuroptera. The costal space is wide and well marked, and the transverse veinlets are few and far apart compared with the two orders just mentioned.

The abdomen is cylindrical, and there are 9–10 uromeres. The ovipositor is only developed in Raphidia, while the cercopoda are not developed. The metamorphosis is complete, as in the Lepidoptera, etc., the pupa being entirely unlike the larva, and quiescent, often protected by a cocoon or case. The order may be divided into two suborders:

1. *Planipennia* (Sialidæ, Hemerobiidæ, Panorpidæ).....
2. *Trichoptera* (Phryganeidæ).

The following tabular view will in a degree express our views

as to the classification of the orders of the hexapodous or winged insects:

SUPERORDERS.	ORDERS.	SUBORDERS.
Euglossata[1]	Hymenoptera	
	Lepidoptera	
	Diptera	Diptera (genuina).
		Aphaniptera.
		Pupipara.
Elytrophora[2]	Coleoptera	Coleoptera (genuina).
		Strepsiptera.
Eurhynchota[3]	Hemiptera	Homoptera.
		Heteroptera.
		Physapoda.
		Mallophaga.
Phyloptera	Neuroptera	Trichoptera.
		Planipennia.
	Pseudoneuroptera	Odonata.
		Ephemerina.
		Platyptera.
	Orthoptera	
	Dermatoptera	
Synaptera[4]	Thysanura	Cinura.
		Symphyla.
		Collembola.

—:o:—

THE POWER OF SCENT IN THE TURKEY VULTURE.

BY SAMUEL N. RHOADS.

IN the *Westminster Review* of 7th month, 1847, occurs an article setting forth the valuable additions Philip Henry Gosse has made to scientific knowledge and the solution of some difficult problems in natural history. The article in hand is a review of Gosse's "Birds of Jamaica," wherein, among other quotations, is given an extended one relating to the sense by which the vulture distinguishes its prey at great distances. A controversy on this subject, during the early part of our century, "set together

[1] We propose the name Euglossata for the highest insects, comprising those orders which, besides having the mouth-parts (either the first or second maxillæ, or both) modified so as to sip, suck or lap up liquid food, also have the body cylindrical, and the thorax more or less spherical and concentrated.

[2] This term is proposed for the Coleoptera alone.

[3] This term is proposed for the Hemiptera, in all of which, except the Mallophaga and Physapoda (Thrips), the mouth-parts are united to form a sucking beak,

[4] This term is proposed for the Thysanuran apterous Hexapods, which are perhaps nearly the morphological equivalents of either of the three other superorders.

by the ears" two opposing parties of naturalists, one side contending that the sense of sight was solely employed in foraging, their opponents attributing to the sense of smell alone the necessary guidance on such occasions. The perusal of this interesting paper brought to mind two incidents somewhat parallel to those related by Gosse, which I observed during the past summer (1882) in New Jersey, one in particular being proof positive to my own mind that the olfactories of a turkey vulture (*Cathartes aura*) can alone serve its purpose in the discovery of food.

The facts on which I base so decided an opinion may be worthy of presentation to the reader.

Whilst digging sweet-potatoes I noticed a very luxurious growth of the vines covering a small mound in the field, and inquiry revealed the fact that a horse and cow had been buried there some years before. Just then nothing impressed me in that connection save the immensity of the potatoes which we found overlying these two graves, but in the afternoon, and during the following day, "buzzards" shadowed the farm by scores, seeming to obey from all quarters of the heavens a mysterious summons to convocation.

I soon perceived the sweet-potato field was the "radiant point" of each speeding shadow. Buzzard after buzzard I traced as they appeared in various portions of the sky with half-folded wings, reminding me of mute, ærial hounds, "coming down the scent," their course, as swift, silent, and undeviating as an arrow's. 'Twas a strangely interesting spectacle to behold them swoop within a few feet of the horse-hades, and rise again with slow, reluctant flaps, indicative of disappointment, then return to deliberately "beat" and "quarter" the ground, ærially speaking, with all the tact and persevering sagacity of their canine compeers; in fact the performance was suggestive of a fox-hunt, in which reynard's place was represented by the dead bodies, "earthed" in this case, however, for other than reynard reasons.

One of the vultures in particular showed an extreme faith in the guidance of its smelling powers by alighting without demur on the fence half a dozen paces from the centre of attraction, where, after some time of manifest uneasiness and uncouth posturing, it was joined by a few of its more dubious companions.

This visitation of uncanny birds continued long after, though I never saw so many as at the first when the crop was plowed

out, this disturbance probably releasing for a time the pent-up odors.

I could detect no taint in the atmosphere of the place even whilst working in the freshly-plowed ground, yet hundreds of buzzards assembled from far and near, and with unerring accuracy pointed out the place of burial with overshadowing wings. In consequence of these observations the theory that the vulture family are enabled to detect the existence of a dead body by scent, unassisted by any of the remaining senses, and this too at great distances, and when such carcass had laid deep under the ground for several years, was to me satisfactorily proven. Gosse, as I before stated, gives an instance confirmatory to the one just related, justly attributing to the same species of vulture this wondrous faculty of tracking its prey from afar. It was observed in Jamaica:

"A poor German immigrant, who lived alone in a detached cottage in this town, rose from his bed after a few days' confinement by fever to purchase in the market some fresh meat for a little soup. Before he could prepare the several ingredients of herbs and roots, and put his meat in water for the preparation of his pottage, the paroxysm of his fever had returned, and he laid himself on his bed exhausted. Two days elapsed in this state of helplessness and inanimation, by which time the mass of meat and pot herbs had putrefied. The stench became very perceptible in the neighborhood, vulture after vulture as they sailed past were observed always to descend to the cottage of the German, and to sweep round as if they had tracked some putrid carcass, but failed to find exactly where it was."

The same authority proceeds to prove furthermore that not only does the object of contention make use of its nose, but also of its eyes in the search for subsistence. I will give this quotation also:

"Some few days succeeding this occurrence, after a night and morning of heavy rain, in which our streets had been inundated to the depth of a foot, and flood after flood had been sweeping to the river the drainage of the whole town, a piece of recent offal had been brought down from some of the yards where an animal had been slaughtered and lodged in the street. A vulture, beating about in search of food, dashed in a slanting direction from a considerable height, and, just resting without closing his wings, snatched up the fresh piece of meat and carried it off.

"Here was the sense of sight unassisted by that of smelling, for the meat was too recent to communicate any taint to the morning air, and the vulture stooped to it from a very far distance."

That any animal with eyes, especially bird's eyes, should not use them in connection with its other senses is undeniable, yet to say that the vulture is gifted with a strength of vision extraordinary as its powers of smelling is very open to dispute.

By analogy we may reason that as no member of the bird-world is preëminently blessed in more than *one* of its senses, as hawks, eagles, and owls by seeing, having wonderfully developed eyes, or the ducks, sandpipers, and curlews by feeling, having wonderfully sensitive and discriminating mandibles, why not then restrict the vulture, whose development of nostrils is enormous compared with that of its other organs of sense to smell. The conclusion of Gosse just given, *i. e.* that "the sense of sight" in finding "the piece of offal" was "unassisted by that of smelling" because "the meat was too recent to communicate any taint to the morning air, *and the vulture stooped to it from a very far distance*," is too hasty, especially the part I have italicized. It looks as if he thought the "distance" would exclude the possibility of the bird having scented the flesh so far, and this, too, in the face of his previous argument that its unassisted power of scent was so wonderful at like distances.

How do we know either that the offal was too fresh to taint the morning atmosphere? Rather than this would it not be fairer to conclude, after such proof of the extreme sensitiveness of the vulturine olfactory, that the scent of newly-slaughtered flesh, however imperceptible to the human nose, is as easily detected by these accomplished scavengers as we men would discover our proximity to some offensive carcass?

That vultures seek and devour newly killed and even living animals is well established, notwithstanding the experiments of Waterton on the turkey buzzards of Demerara, in which he not only noticed they never attacked the numerous reptiles in their easy reach, but "he even killed lizards and frogs and put them in their way, but they did not appear to notice them until they attained the putrid scent."

Experiments with wild animals are unreliable methods of determining the value of hypotheses. To thus beg the question of nature is unnatural, and such methods of inquiry are mostly "given the lie." 'Tis too much like torture for a confession than an entreaty for the true responses of nature's oracle. Audubon overlooked this truth when the fact of some confined vultures not

noticing the presence of a covered basket of carrion placed among them, decided him forever against the ideas I have endeavored to prove in this paper.

I find in the introduction to "A Manual of the Ornithology of the United States and Canada," by Thomas Nuttall, a short paragraph referring to this self-same experiment, and, as it echoes the sentiments of his friend Audubon, whose follower he was, with other naturalists of that day, I will finish by its quotation:

"Comparing animals with each other we soon perceive that smell in general is much more acute among the quadrupeds than among the birds. Even the pretended scent of the vulture is imaginary as he does not perceive the tainted carrion on which he feeds through a wicker basket, though its odor is as potent as in the open air."

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THE SIPHONOPHORES.

BY J. WALTER FEWKES.

(Continued from February number, 1882.)

V.—The Diphyæ.

THERE remain of tubular Medusæ yet to be mentioned a few genera closely related to Diphyes[1] which form a characteristic group called the Diphyæ.[2] While all of these jellyfishes like Agalma and the majority of its relatives are furnished with a long tube like axis, none of them have at one end of this stem an air bladder for flotation in the water or upon its surface. Most of the animals which we are now to consider have swimming-bells as means of self propulsion by which they move through the water with a velocity which is very great when compared with many of their float-bearing relatives. As a rule, however, the members of the division are smaller than the Physophoræ, and the gelatinous substance of their swimming-bells is generally of a firmer consistency. The group may be said to include some of the most specialized forms of the Siphonophores.

The Diphyæ with the exception of at least one genus called

[1] For a popular account of the anatomy of Diphyes the reader is referred to the AMERICAN NATURALIST for February, 1882.

[2] The terms Physophoridæ and Diphyidæ are family names and should give place to Physophoræ and Diphyæ, which may be applied to groups containing several families.

Monophyes[1] have, like Diphyes, two swimming-bells or nectocalyces. The most apparent difference in external shape between the genera which compose the group lies in the modification in size and shape of one or the other of these structures.

The genus of Diphyæ which resembles Diphyes most closely is known as Galeolaria (Epibulia). By many writers on these animals, instead of being regarded another genus it is simply called a species of Diphyes. It is larger, however, than the latter, and capable of very rapid motion, darting hither and thither through the water, principally by the contractions of the posterior of its two swimming-bells.

Galeolaria is widely distributed in the different seas, being very common in the Mediterranean. In American waters it has been taken off the Florida Keys in the Gulf Stream near Nantucket and is likewise recorded as far north as the latitudes of Greenland.

The variation in the shape of their swimming-bells is one of the most prominent differences between it and Diphyes. While in both genera these structures are two in number in *Galeolaria aurantiaca* Vogt, both are much larger than in our common Diphyes, *D. formosa* F. The anterior swimming-bell of the former genus is less conical in shape than that of the latter and as far as external appearance goes seems less perfectly adapted to rapid progress through the water. The part of the anterior bell which is in advance as it moves through the water is rounded and blunt as compared with the pointed conical end of the bell in Diphyes. Upon this end there is the most resistance in onward motion through the water, for it is the anterior portion of the animal as it forces its way along in the direction in which it swims. While, however, it is the anterior end of the bell as it moves forward, it is not homologous to the apex of other medusa bells, but is morphologically one side of such a bell, or one wall which has become very much thickened and modified in such a manner that in its sidelong motion it may encounter the least resistance from the surrounding water.

There are deep-seated internal differences between the anterior of the two nectocalyces in the genera Diphyes and Galeolaria,

[1] The same is true, according to Chun, in Muggiæa. Specimens of a Diphyes with but one nectocalyx are very common in Bermuda and Tortugas. I had formerly supposed with the majority of authors that they were mutilated specimens of Diphyes. They resemble closely the genus Muggiæa as limited by Chun.

although their outward resemblances are so close. A somatocyst and bell cavities exist in both. The radial chymiferous tubes have the same inequality in length and a like tortuous course brought about by the unequal development of the bell walls. One peculiarity of the radial tubes in the bell of Galeolaria is that two of the four radial vessels are connected by a smaller vessel or lateral branch which extends through the bell walls parallel with its rim. The posterior swimming-bell of Galeolaria likewise differs in shape from that of Diphyes. One of the most interesting of the differences in general form is the existence in Galeolaria of two circular gelatinous plates which extend backward from the lower side of the posterior bell rim, one on each side of the median line. These small disks have an important function to perform in the movements of the medusa, for they serve as rudders by which the direction which the water takes on leaving the bell cavity is determined. The steering of the animal while it is in motion is thought by some to be brought about in the following manner: When the lower bell by a simultaneous contraction of its walls on all sides drives the water violently from its cavity through the bell opening, the liquid thus expelled strikes the surrounding medium and meets with a resistance. The result is that the animal itself is driven forward. The direction which the water takes as it leaves the bell depends upon the angle at which these disks are set on the bell margin, and by altering this angle the direction in which the animal moves is determined. Both anterior and posterior bells in Galeolaria contribute to the onward motion, although propulsion is brought about in the main by the posterior.

In the genus next to be noticed, allied in many respects to those already studied, the disproportion in size of the two swimming-bells is very apparent on account of the anterior bell being so very much reduced in size. As it is much smaller than the posterior it performs only a very small amount of work in the onward motion of the medusa. A genus which possesses these characters is called Abyla.[1]

Abyla is smaller than Galeolaria and somewhat larger than Diphyes. It is more sluggish in its movements than either, and consequently more easily captured.

[1] Abyla is very common in the Mediterranean, but has not yet been taken on our coasts.

The anterior bell (*a*) is distinguished by some of the most important characters of the genus. It is very small and has a rhomboidal shape. The anterior end is not conical as in Diphyes nor rounded as in Galeolaria. The bell walls are stiff and the bell cavity and bell opening relatively very small. Most of the interior of the bell is taken up by a large somatocyst of globular shape. The anterior and posterior bells fit closely together by faces, of which that of the anterior is slightly concave.

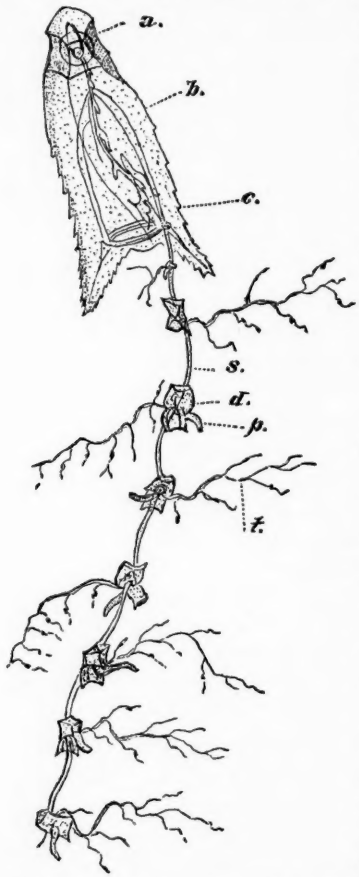

FIG. 1.—*Abyla pentagona* (side view). *a*, anterior bell; *b*, posterior bell; *c*, longitudinal canal with cover; *d*, diphyizoöid; *s*, stem; *t*, tentacle.

The posterior swimming-bell (*b*) differs widely in shape from that of either Diphyes or Galeolaria. Unlike the latter there are no circular plates or rudders on the bell margin. From the point of union of anterior and posterior bells there passes from one end of the nectocalyx to the other a number of serrated ridges, five of which are continued into triangular projections below the bell opening. Upon one side of the bell between two of the more prominent of these parallel ridges there is a groove (*c*) for the lodgment of the axis when retracted. This groove lies on the same side of the posterior swimming-bell as the opening into the anterior bell cavity. Throughout a part of its length from the anterior bell, for two-thirds of the distance to the termination, this groove is covered by a thin transparent plate formed by a reflexion of one of the neighboring longitudinal ridges. The

function of this groove and its cover, the thin plate which has been mentioned, is to form a receptacle into which the retracted stem and its attached members can be wholly or partially withdrawn. The modification in the form of the bell, resulting from the formation of the groove and its cover, gives rise to a complication in the course of the radial canals in the bell walls. While three of these tubes have a normal course extending directly from a common origin to the bell margin; a fourth which lies on the same side as the groove or external canal and its cover, is somewhat modified. It starts from a common union with the others, but instead of passing directly to the bell margin divides midway in its course into two branches. One of these branches ends blindly in the bell walls a short distance from the bifurcation, while the other after a tortuous course eventually ends in the immediate vicinity of the bell margin.[1]

The diphyizoöid of Abyla (Figs. 2, 3, 4) closely resemble those of Diphyes in many particulars. The covering scale (*cs*) is, however, polygonal in shape instead of hemispherical, and almost its whole interior is taken up by a large somatocyst (*s*). The swimming-bell, clusters of male and female sexual bells, tentacle and polypite are similar to those of Eudoxia.

The diphyizoöid of Abyla, like that of Diphyes, was formerly described as a genus widely different from that to which it is now known to belong. Historically it is interesting from the fact that from a study of its anatomy and growth the true nature of the diphyizoöid in general was recognized.

The reduction in size in the bell of Abyla has gone so far in a genus called Monophyes that the anterior bell is missing and we find a single swimming-bell which has resemblances to both the anterior and the posterior nectocalyces of the genera which have already been described.

The single swimming-bell of Monophyes has a hemispherical shape and is without ridges on its external surface. On one side of the bell walls there is an enclosed canal out of the opening into which hangs the axis. The axis or stem can be withdrawn into the canal where, when retracted, it is securely packed in the same way that a like organ of Abyla is placed in the groove

[1] A blindly ending tube also arises from the point of union of a radial and circular tube and extends to the neighborhood of the plate which has been described above.

covered by the gelatinous plate. The swimming-bell of Monophyes resembles the posterior bell of Abyla in its possession of

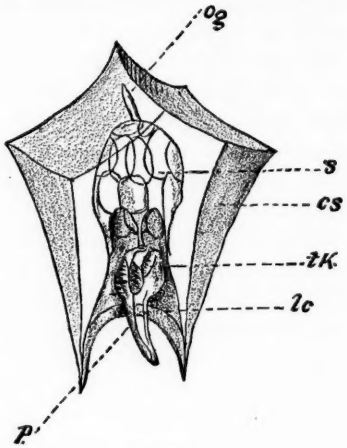

Fig. 2.

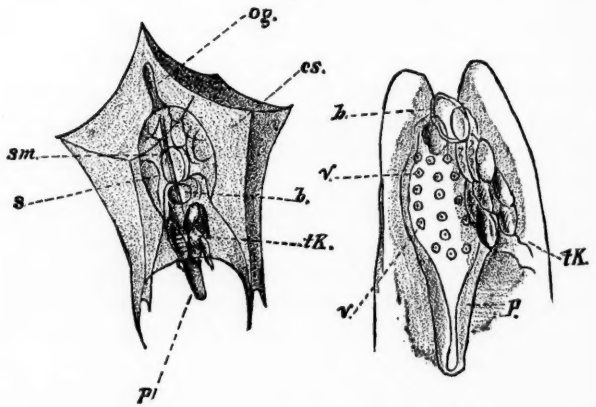

Fig. 3. Fig. 4.

FIG. 2.—Diphyizoöid of Abyla (?) (Aglaisma). FIG. 3.—The same from upper side. FIG. 4.—Polypite of Aglaisma. *b*, budding sexual bells; *cs*, covering scale; *lc*, longitudinal canal on the under side of the covering scale; *og*, oil globule, part of the somatocyst; *p*, polypite; *s*, somatocyst; *sm*, tube in covering scale; *tk*, tentacular knobs; *v*, villi on inner side of polypite.

this cavity. There is also in the walls of the bell of Monophyes a blindly ending tube communicating with the cavity of the axis which corresponds with the somatocyst of the

anterior bell. The strict homology of the single nectocalyx of Monophyes is therefore difficult to determine. In connection

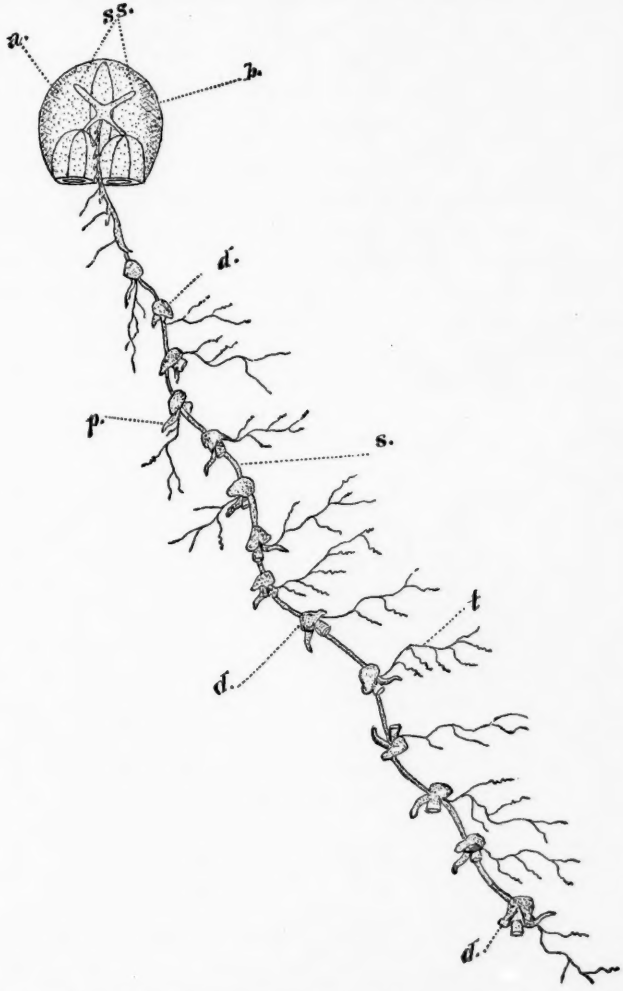

FIG. 5.—*Praya diphyes* Köll. *a*, anterior bell; *b*, posterior bell (nectocalyx); *d*, covering scale; *p*, polypite; *s*, stem; *ss*, somatocyst; *t*, tentacle.

with Monophyes a very curious medusa from Newport, R. I., as well as from many other localities, ought to be mentioned. This

medusa is called *Diplophysa mermis*, and is regarded by many authors as the diphyizoöid of this genus.

There are several of the tubular medusæ belonging to the Diphyæ which depart very widely in general form from that assumed by Diphyes, although they are evidently more closely related to these than to the genus Agalma and its relatives. One of the most beautiful of these is a genus Praya,[1] of which several species have been described (Fig. 5). Praya has two nectocalyces at one extremity of a long, highly flexible axis or stem, which fit together side by side with the openings into their cavities facing outward and backward in the direction of the stem. Each bell is almost globular and has very flexible walls. In one species[2] one of the bells is much larger than the other, but in the others they are of about the same size. In many respects the swimming-bells of Praya are peculiar. One species (Fig. 5) has a somatocyst (*ss*) in both of the swimming-bells, while in others this structure is confined to one of the bells, as in other Diphyæ. The radial tubes in the species take a direct course from a common junction to the bell margin.

The axis (*s*) is not capable of being drawn up into the interval between the bells, but as the animal swims in the water trails far behind and is thrown into many graceful curves by the onward motion. This stem, when extended, is found to bear at intervals along its length little helmet-shaped transparent bodies (*d*) which in general shape resemble the primitive covering scale of the larval Agalma. The helmet and accompanying structures presently to be described, form the diphyizoöids which in the subsequent growth of the Praya fall off one by one. After they have thus separated themselves from their attachments, they develop into medusæ of very different outward shape from that of the attached young (Fig. 6).

Although the helmet-shaped body (*p*) gives these diphyizoöids their form, they are by no means the only structures in the clusters. They cover other organs of a most important character. Below each helmet-shaped body we find a small botryoidal cluster of bells bearing ova and probably spermatozoa, and a flask-shaped stomach (polypite) (*e*) which resembles a similar body in

[1] Named from Porto Praya in the Cape Verde islands.

[2] The species of the Praya found in the Gulf of Mexico is probably new. Bull. Mus. Comp. Zoöl., Vol. IX, 7.

Eudoxia. From the base of this polypite there hangs a tentacle (*i*) which has many side branches, each of which bears a simple pendant knob. The whole tentacle with lateral branches is easily retracted under the helmet-shaped covering scale, as is shown in Fig. 6. As the Eudoxia separates from the Diphyes and leads an independent existence, so the helmet-shaped members of the Praya colony separate from it, and after subsequent growth assume a very different shape from that which they have when attached. Although it is not yet known what the ultimate condition of the separated fragment is, there is probably no doubt that it later acquires a very different form as it grows older.

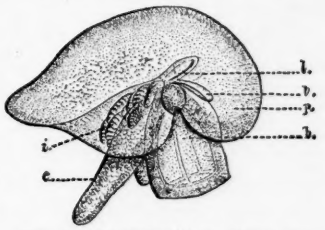

FIG. 6.—Diphyizoöid of *Praya cymbiformis* (d Ch.) Leuck. *b*, sexual bell; *e*, polypite; *i*, tentacle retracted, with tentacular knobs; *ll*, somatocyst; *p*, helmet-shaped body.

There are two well-marked species of Praya found in the Mediterranean sea, which are known as *P. cymbiformis* Leuck., and *P. diphyes* Köll.; they differ from each other in the relative size and shape of the swimming-bells and in a character already pointed out of the absence or presence of somatocysts in the posterior bell. In still a third species from the Bay of Villa Franca in Provence, we find the different attached diphyizoöids so closely crowded together that they touch each other side by side along the length of the stem. This species, *Praya gracilis* F., is smaller than the others, has swimming-bells of a different shape and the openings into the bell cavity are larger and open more on the sides than in the above species.

One of the most interesting genera of floatless Siphonophores is a genus called Gleba or Hippopodius, which is very common in the Mediterranean. This genus is placed by many writers on these medusæ among the Diphyæ, but its many differences from the other genera are so great that it should probably be made the type of a new group equal in rank to the Physophoræ and Diphyæ. The Siphonophoræ[1] will then be divided into three

[1] Exclusive of Velella (Rataria) and Porpita, aberrant genera which have few likenesses with the true Siphonophores and which are called Discoideæ. These medusæ are more closely related to floating hydroids than to medusæ with attached buds.

divisions, of which Agalma, Diphyes and Gleba are representative genera.

Gleba resembles the Physophoræ in possessing many swimming-bells, and the Diphyæ in being destitute of a float. Diphyizoöids, if such exists, are unknown, and an opposite law from that which exists in Agalma is followed in the order of development of the nectocalyces on the nectostem. The group of Hippopodiæ contains the two genera Gleba and Vogtia. The American representative is the genus Gleba, which is found in the Gulf Stream.[1] Vogtia is probably the young of Gleba. The swimming-bells of Gleba are hoof-shaped structures and are arranged in two rows or series, the opposite members of which fit closely together. The resemblance in shape of each bell to a horse's hoof is very striking. The upper portion of the hoof points downward and outward, and upon its face is found an opening, the bell orifice, into a shallow bell cavity. The lower surface is concave, and as the animal swims is uppermost in the water. The bell substance although gelatinous and transparent, is less flexible than that of most other Siphonophores. The bell walls have little or no power of contraction and expansion, and the bell approaches closely in structure the covering scales of several other Siphonophora.

The velum of the swimming-bell has a crescentic shape, and by its strokes upon the water, rather than by the contractions of the bell walls, the medusa is driven from place to place. The shallowness of the bell cavity and the irregular shape of the bell itself brings about a variation in the regular course of the tubes of the bell. One of the radial tubes of the bell is much larger than the others, although all pass directly from a common origin to the circular marginal tube. This long tube is swollen midway in its course into a flat disk-shaped cavity or enlargement of unknown function and homology. The somatocyst lies just below the floor of the concave face of the bell, opposite the bell opening, and has a tubular form. It closely resembles the central tube of the covering scales of Agalma. As it is probably homologous with the somatocyst of other Diphyæ, it gives us a hint of the homology of the central tube of the covering scale. The somatocysts, wherever found, are the same as the "mantle tubes" in Agalma. There are no true covering scales without

[1] Bull. Mus. Comp. Zoöl., IX, 8.

bell cavities as in Agalma and some other Physophoræ. The size of the swimming-bells of Gleba follow an opposite law of decrease in size from that which exists in Agalma. In Agalma the bells near the float are very small, simple buds, while their size increases as we recede from that point. Those, however, which make up the most distant portion of the series are of about equal size. An opposite law exists in Gleba, for the swimming-bells near the end of the stem opposite that from which the polypites hang are the largest and those at the other extremity of diminutive size. By the arrangement of bells in Gleba those placed highest, as the animal naturally swims, are small, and those lowest are well developed, so that the axis is reversed as compared with that of Agalma. The polyp stem is inconspicuous or wholly wanting. The polypites and their appendages seem to hang from the upper end of the nectostem. The differences between Gleba and Vogtia are mainly in the form of the nectocalyces, and by many the latter genus is regarded the young of the former. Much obscurity, however, still hangs about the anatomy and development of both these most interesting genera.

The following more or less artificial classification is presented as an aid to beginners in a study of these Siphonophora. The genera known from our waters are designated by an asterisk (*):

SIPHONOPHORA.

Polymorphic medusæ generally with a tubular formed body. With or without a float. Young and adult free-swimming. With flask-shaped stomachs called polypites and long contractile tentacles. Many have swimming-bells, covering scales and tasters. Colonies monœcious or dicœcious. Reproduction (always) generally by eggs.

A.—With a float.

Physophoræ.

I.—Without axis, covering scales or nectocalyces.

Physaliadæ.[1]

**Physalia arethusa* Til.

II.—With an axis.

a. Without covering scales or nectocalyces.

Rhizophysidæ.

**Rhizophysa filiformis* Forsk.

**Rhizophysa gracilis* F.

**Rhizophysa eysenhardtii* Geg.

[1] In a natural system of classification Physalia and Rhizophysa should be separated from the other Physophoræ, and form a new group of equal rank. For these Chun suggests the name Pneumatophoridæ (Pneumatophoræ).

b. With nectocalyces, without covering scales.
Physophoridæ.

c. Without nectocalyces, with covering scales.
Athorybiadæ.
**Athorybia formosa* F.

d. Nectocalyces in several series with covering scales.
Forskaliadæ.
**Stephanomia atlantica* F.

e. With nectocalyces in two rows, with covering scales.
Agalmidæ.

1. Tentacular knobs with involucrum and many terminal filaments.
Calliagalma F.

2. Tentacular knobs with involucrum and two terminal filaments.
**Agalma elegans* F.
**Crystallodes rigidum* Hæck.

3. Tentacular knobs with involucrum and one filament.
**Agalmopsis fragilis* F.

4. Tentacular knobs without involucrum, with one terminal filament.
Halistemma Huxley.

Polyp-like bodies on the nectostem between the nectocalyces.
Polyp stem with appendages in clusters.
Apolemiadæ.
**Apolemia* sp.

Doubtful genera and species from American waters:
**Nanomia*[1] *cara* A. Ag.
**Haliphyta*[2] *magnifica* F.

B.—Without a float. Flotation sometimes effected by an oil globule in one or both (?) nectocalyces.

I.—Several nectocalyces.
Hippopodiæ.
**Gleba hippopus* Forsk.

II.—One or two nectocalyces.
Diphyæ.

a. One nectocalyx.[3]
Monophyidæ.

b. Two nectocalyces.

1. Nectocalyces with flexible walls of about equal size, arranged side by side.

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[1] The peculiar development of Nanomia, described by A. Agassiz, is different from that of any other known Physophore. It resembles in many particulars Halistemma, but as its adult tentacular knobs are unknown, I am unable to refer it to this genus. The absence of a primitive scale in the young allies it to Agalmopsis as I have limited the name.

[2] The tentacular knobs of Haliphyta are unknown.

[3] Muggiæa, as limited by Chun, would also come under "B, *a*" if a posterior nectocalyx is never developed and not broken off as formerly supposed. One species of this genus is sometimes found in North American waters.

Prayidæ.

**Praya blaino.*

2. Anterior bell conical or rounded, posterior with marked longitudinal sides. Swimming-bells of about equal size.

Diphydæ.

**Diphyes acuminata* Lkt.

**Diphyes formosa* F.

3. Anterior bell small, polygonal in shape. Posterior bell with longitudinal canal covered with a plate.

Abylidæ.

There are a few genera of Mediterranean Siphonophores which are introduced in the above key since they represent families which probably occur in the Gulf Stream, although they have not yet been taken on our coast.

——:o:——

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

The long persistence of the mediæval type of education which prevails in our schools and colleges has rarely been more happily and forcibly stated than by Charles Francis Adams, Jr., in his address before the late meeting of the Phi Beta Kappa Society. His adverse criticism is chiefly directed against the great waste of time involved in the study of Greek literature; and in the true scientific method he appeals to the facts best known to himself in proof of the position he assumes. The examples he cites are the lives of his ancestors, commencing with John Adams, President of the United States, who graduated at Harvard University in the class of 1755. We cannot do better than transfer to our pages some of his remarks:[1]

"And so for us the college course, instead of being a time of preparation for the hard work of life, was a pleasant sort of vacation, rather, which preceded it. We so regarded it. I should be very sorry for myself not to have enjoyed that vacation. I am glad that I took my degree. But as a training place for youth, to enable them to engage to advantage in the actual struggle of life, to fit them to hold their own in it, and to carry off the prize, I must in all honesty say that, looking back through the years and recalling the requirements and methods of the ancient institution, I am unable to speak of it with respect. Such training as I got, useful for the struggle, I got after instead of before graduation, and it came hard; while I never have been able—and now, no matter how long I may live, I never shall be able—to overcome some great disadvantages which the superstitions and wrong theories and worse practices of my alma mater inflicted upon me.

[1] The Boston *Herald*, June 29, 1883.

And not on me alone. The same may be said of my contemporaries, as I have observed them in success and failure. What was true in this respect of the college of thirty years ago is, I apprehend, at least partially true of the college of to-day; and it is true not only of Cambridge, but of other colleges, and of them quite as much as of Cambridge. They fail properly to fit their graduates for the work they have got to do in the life that awaits them.

"This is harsh language to apply to one's nursing mother, and it calls for an explanation. That explanation I shall now try to give. I have said that the college of thirty years ago did not fit graduates for the work they had to do in the actual life which awaited them. Let us consider for a moment what that life has been, and then we will pass to the preparation we received for it. When the men of my time graduated * * * the railroad and the telegraph were in their infancy; neither nitro-glycerine nor the telephone had been discovered. The years since then have been fairly crammed with events. A new world has come into existence, and a world wholly unlike that of our fathers—unlike it in peace and unlike it in war. It is a world of great intellectual quickening, which has extended until it now touches a vastly larger number of men in many more countries than it ever touched before. Not only have the nations been rudely shaken up, but they have been drawn together. Interdependent thought has been carried on, interacting agencies have been at work in widely separated countries and in different languages. The solidarity of the peoples has been developed. Old professions have lost their prominence; new professions have arisen. Science has extended its domains, and is superseding authority with a rapidity which is bewildering. The artificial barriers—national, political, social, economical, religious, intellectual—are giving way in every direction, and the civilized races of the world are becoming one people, even if a highly discordant and quarrelsome people. We all of us live more in the present and less in the past than we did thirty years ago, much less in the past and much more in the present than those who preceded us did fifty years ago. The world as it is may be a very bad and a very vulgar world, insincere, democratic, disrespectful, dangerous, and altogether hopeless. I do not think it is; but with that somewhat comprehensive issue I have, here and now, nothing to do. However bad and hopeless, it is nevertheless the world in which our lot was cast, and in which we have had to live—a bustling, active, nervous world, and one very hard to keep up with. This much all will admit; while I think I may further add that its most marked characteristic has been an intense mental and physical activity, which, working simultaneously in many tongues, has attempted much and questioned everything.

* * * * * * *

"How did Harvard College prepare me and my ninety-two classmates of the year 1856 for our work in a life in which we have had these homely precepts brought close to us? In answering the question it is not altogether easy to preserve one's gravity. The college fitted us for this active, bustling, hard-hitting, many-tongued world, caring nothing for authority and little for the past, but full of its living thought and living issues, in dealing with which there was no man who did not stand in pressing and constant need of every possible preparation as respects knowledge and exactitude and thoroughness—the poor old college prepared us to play our parts in this world by compelling us, directly and indirectly, to devote the best part of our school lives to acquiring a confessedly superficial knowledge of two dead languages."

After narrating the history of his ancestors' connection with Harvard, and showing the small value to their subsequent careers of the Greek they there so laboriously acquired, he speaks as follows:

"Such is a family and individual experience covering a century and a half. With that experience behind me, I have sons of my own coming forward. I want them to go to college—to Harvard College—but I do not want them to go there by the path their fathers trod; it seems to me that four generations ought to suffice. Neither is my case a single one. I am, on the contrary, one of a large class in the community, very many of whom are more imbued than I with the scientific and thorough spirit of the age. As respects our children, the problem before us is a simple one, and yet one very difficult of practical solution. We want no more classical veneer. Whether on furniture or in education, we do not admire veneer. Either impart to our children the dead languages thoroughly, or the living languages thoroughly; or, better yet, let them take their choice of either. This is just what the colleges do not do. On the contrary, Harvard stands directly in the way of what a century and a half's experience tells me is all important."

These extracts suffice to show the feeling with which one of the most thoroughly Harvardized of Boston's children regards his alma mater. But we are glad to know that the Harvard of to-day offers ever increasing facilities for the acquisition of positive knowledge, and for the training of the mind in the apprehension and pursuit of truth. Any other course would be suicidal, and in failing to adopt it, the majority of our colleges are simply digging their own graves.

RECENT LITERATURE.

JOLY'S MAN BEFORE METALS.[1]—The author's aim in publishing this book has been, as he says, to bring before the reader the numerous proofs hitherto collected of the great age of the human race, as well as to treat of the customs, the industry as well as the moral and religious ideas of man, such as he was before the use of metals was known to him, and in conclusion to briefly sketch the possible appearance of this being. While the work is by no means to be ranked with those of Lyell, Tylor, Lubbock, Wilson, Dawkins and others, it may be read with interest because written by a Frenchman, for it will be remembered that Frenchmen such as Boucher de Perthes, Broca and others, were the pioneers in modern inquiries into the antiquity of the human race. The author is mainly expository, at times critical, at other times strangely credulous and too much disposed to quotations. The chapter on early man in America is the least valuable in the book, and strangely obsolete. For example, though apparently written in 1882, at least published in 1883, no mention is made of the records of early man in California, or in the river gravels of New Jersey. On the other hand as proofs of the antiquity of man in the United States, we are treated once more to the statements of Dr. Dowler regarding the New Orleans skeleton, to the very questionable Natchez pelvis, which may have been washed out of a recent Indian cemetery; also to the oft-quoted misstatement regarding the human bones "extracted by Agassiz" from a calcareous conglomerate which forms part of a coral reef in Florida," etc. A strange want of familiarity with recent American archæological literature is shown. Reference on p. 163 is made to "the recent discovery of a human skull picked up at Jacksonville, on the banks of the Illinois, one hundred feet above the present level of the river, and remarkable, like that of Neanderthal," etc. This statement we presume refers to the calvarium dug out by the late Professor Wyman from the shell-heaps of Jacksonville Florida.

On the other hand the account of the French caves and Swiss lake dwellers is excellent, and the figures, which we here reproduce, will elucidate the subject. It appears that the lake dwellers were in Switzerland preceded by dwellers in caves who date from the Palæolithic period.

The author appears to adopt Worsaës' opinion, shared by Keller, Desor and Virchow, that the Neolithic lake dwellers were of Keltic origin.

The chapter on antediluvian art, particularly that of the Palæolithic cave dwellers, is well prepared and illustrated, as will be seen by the accompanying illustrations selected from this chapter.

The author does not go to extremes, either in his views as to

[1] *The International Scientific Series. Man before Metals.* By N. JOLY. With 148 illustrations. New York, D. Appleton & Co., 1883. 12mo, pp. 385.

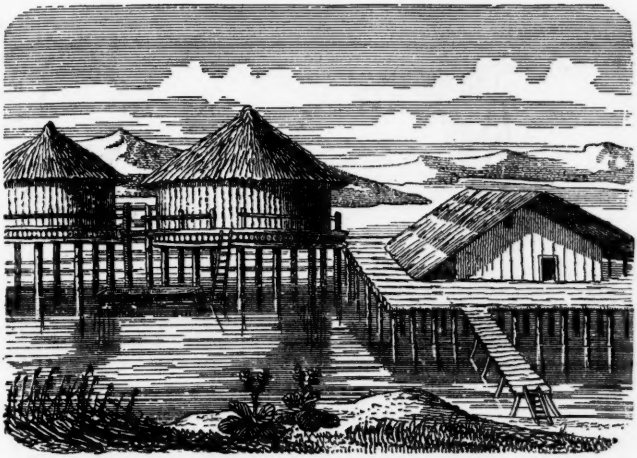

FIG. 1.—Ancient Swiss lake dwellings, in part restored by comparison with the lake huts of modern savages in New Guinea.

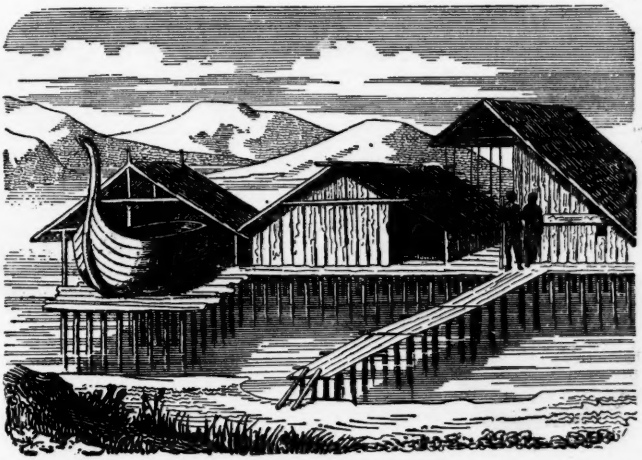

FIG. 2.—Modern shore dwellings of the inhabitants of New Guinea. After Dumont d'Urville.

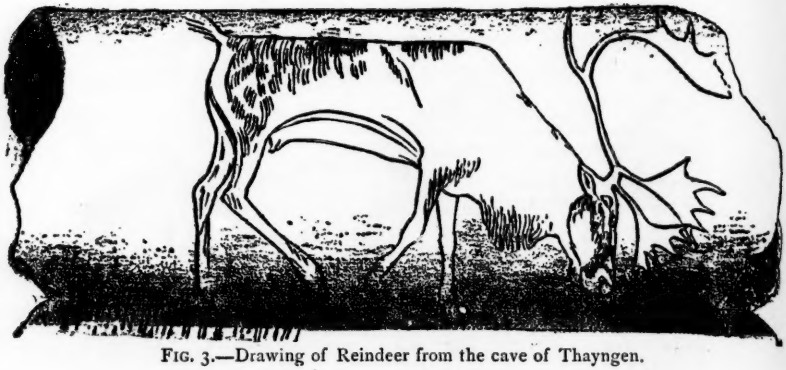

FIG. 3.—Drawing of Reindeer from the cave of Thayngen.

FIG. 4.—Horse engraved in outline upon reindeer horn.

FIG. 5.—Figure of a naked man between two horses heads.

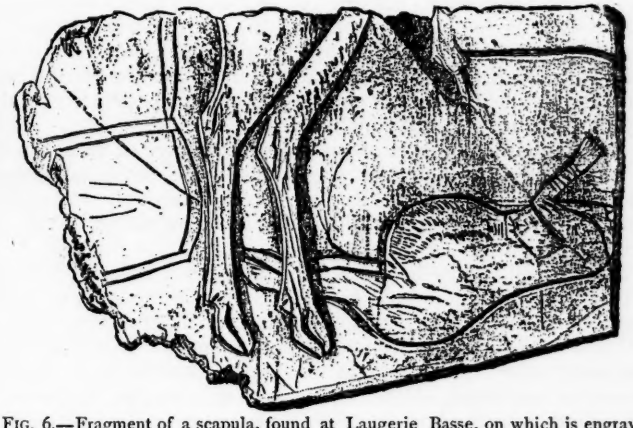

FIG. 6.—Fragment of a scapula, found at Laugerie Basse, on which is engraved the figure of a pregnant woman.

the antiquity of man nor as to his origin, which he acknowledges to be as yet wrapped in obscurity, and he is candid and generally critical in his views, but not always inclined to sift his authorities, hence while the book is very readable it is not always to be implicitly trusted.

SECOND GEOLOGICAL SURVEY OF THE ANTHRACITE COALFIELDS OF PENNSYLVANIA.—The survey of these fields was commenced in August, 1880, under the direction of Mr. Charles A. Ashburner, geologist in charge, and the first results of the work done, published by the State, have just appeared in the Panther Creek Atlas, which contains eleven sheets, twenty-six by thirty-two inches, relating to the geology of the extreme eastern end of the Southern (Schuylkill) coalfield, lying between Mauch Chunk, in Carbon county, and Tamaqua, Schuylkill county, as follows: Three mine sheets, showing the horizontal plan of the mines, and the geological structure of the coal beds by contour curve lines, fifty feet vertically apart, drawn in the floor of the Mammoth bed, scale 800 ft. = 1 in.; three cross-section sheets, showing the vertical structure of the coal beds, scale 400 ft. = 1 in.; three columnar section sheets, showing the thickness of the coal

beds with their included slate and bony layers, and the thickness and character of the rocks between the respective beds, drawn on the following scales: coal-bed sections 10 ft. = 1 in., coal-measure sections 40 ft. = 1 in., conglomerate (mill-stone grit) sections 100 ft. = 1 in.; one topographical sheet, showing the surface features of the same area covered by the mine sheets, scale 1600 ft. = 1 in.; and one sheet showing the development of the surface of the highly-flexured Mammoth bed into a horizontal plane. In addition to these sheets relating to the Panther Creek basin there is one sheet giving a general map of the entire coalfields, with a list of the working collieries, with their production in 1881, and the thickness of the coal beds and coal measures in the different districts, and also one sheet showing the annual production of the region since 1820 to 1881 inclusive.

Mr. Ashburner's report of progress descriptive of these sheets is now going through the press; his more technical discussion of the geology of the Panther Creek basin will not appear until his final report is published, after the completion of the entire survey.

The special methods which Mr. Ashburner has devised, and which have been approved by J. P. Lesley, State geologist, deserve particular notice, since they have, without doubt, applied the science of geology more directly to the art of mining than has ever before been done by any of the State surveys on the American continent. When this survey was ordered the strongest prejudice existed among the mining men in the coal basins against the possibility of the State corps accomplishing any results which would be of utility in the exploitation of the coal beds. Without the support and coöperation of the mining companies, by which the facts in their possession could be obtained, it would have been useless to have attempted any work. This information was secured by adopting a plan of work which sought to clearly indicate the precise position of each coal bed and the amount of workable coal contained. The practical questions to be answered were: How much coal is there? Where is it? At what depth? With how steep a dip? In what direction? With what basins, and saddles of what length, breadth, depth, and height? In what direction would level drifts run? Where would the coal be best attacked by shafts or drifts? What beds of rock or coal lie above or below the coal worked, and what distance? What is the situation of the coal with reference to water courses or other features on the surface of the ground? and the like. It is easily conceivable that it would be impossible to give indications of that kind so fully and satisfactorily with a whole volume of words as with properly constructed maps and sections on scales large enough for reliable measurements to be taken directly from them. As far as the Panther Creek basin is concerned, which is about one-fortieth

the area of the entire field, these questions are all answered as far as it is *possible* by the facts contained on the present atlas sheets. A noticeable feature of the method of illustration is that all facts which are very numerous are boldly separated from the hypothetical deductions, so that Mr. Ashburner and his assistants give every one the means of verifying, modifying, or disproving their conclusions. This renders the work of more prominent and practical value than much of the geological mapping which is published, and in addition inspires the confidence of practical men.

The plan of representing geological structure of sedimentary strata by underground contours, although not novel in itself, since it has been employed extensively by Lesley in America in private surveys, and Lyman in Japan in government surveys, yet Ashburner deserves the credit of perfecting the method and of practically applying it to the exhibition of the complicated structure of the anthracite coal beds, which have every conceivable angle of dip from 0° of a horizontal position to 35° overturned from a vertical position. With all this bold flexuring not a single break or fault in the strata of the Panther Creek basin is shown in any of the cross-sections, although the mine sheets show several of inconsiderable extent, being all, however, under ten feet. This is a remarkable fact when one recalls the numerous faults found in the comparatively horizontal and undisturbed coal beds of the Yorkshire field, England; maps and sections of which are before us. This difference in the faulting has never been satisfactorily explained by dynamical geologists. We understand that Ashburner is disposed to believe that the plication of the anthracite coal strata took place when they were in a semi-plastic condition, that is before they were thoroughly dried out and hardened. Faults in the bituminous measures of the Appalachian belt have been found of greater extent than the small faults referred to in the Panther Creek basin, for this and other reasons it is probable that the main structural features of the anthracite basins were determined anterior to those of the nearly horizontal bituminous basins back of the escarpment of the Allegheny mountains. The *time* of flexuring may have something to do with the origin of the anthracite, which Ashburner believes must be explained on chemical rather than on geotectonic grounds. Certain it is that no satisfactory explanation has ever been offered for the presence of anthracite instead of bituminous coal in Northeastern Pennsylvania. Anthracite cannot be in any way the *direct* product of forces which produced plications. The Belgian coals contain forty-five per cent of volatile matters, and are even more highly flexured than the Pennsylvania anthracites. The trap dyke theory, so popular with foreign geologists, and not long since strongly advocated by Mr. Edward Hardman,[1] has long

[1] Journal Royal Geological Society of Ireland, Vol. IV, part 3 (New Series).

been exploded by our geologists as accounting for our Pennsylvania anthracites, for there are no trap dyke exhibitions within many miles of the anthracite basins. We shall await with some impatience any explanations which Ashburner will be able to prove with the facts which he is gathering.

A most remarkable thickness of coal is observed in one of the sections of the Mammoth bed measured in the vicinity of the "Old Lehigh Summit Hill mine (quarry)." The thickness perpendicular to its bedding is 114 feet, with 106 feet of workable coal, yet 91 feet away the bed measures only 73 feet thick with but 66 feet of coal. As great a change is observed in the thickness of the coal measure, sandstones and conglomerates (Pottsville conglomerate No. XII, or Millstone grit), from the bottom of the Mammoth bed down to the top of the Mauch Chunk red shale, No. XI (representative of the Mountain, St. Louis, Chester, and Lewisburg, Va., limestones). At Tamaqua these strata measure 1700 feet thick, at Lansford, only five miles to the east, they only measure 900 feet thick, while at the old Hacklebarney tunnel, back of Mauch Chunk, eleven and a half miles east of Tamaqua, and six and a half miles east of Lansford, they have thickened again to 1550 feet. This is a fact quite inconsistent with all previous views which have been held in regard to the structure of the carboniferous conglomerate in the anthracite region. Ashburner offers no explanation other than in a note placed on the sheet which says that it "may show a non-conformability between the conglomerate and the underlying Mauch Chunk red shale No. XI, * * * or a non-conformability between the individual strata forming the conglomerate measures." We understand that the facts developed by these sections with others not yet published lead to the conclusion that during the carboniferous epoch there was a continual subsidence going on in this section rather than successive subsidences and elevations as is generally believed.

The sheet showing the development of the surface of the Mammoth bed gives some interesting facts relating to the ratio of the surface underlaid by the beds, and the actual surface area of the beds. The Mammoth bed, in the Panther Creek basin, underlies 10,708 square miles of surface, whereas the area of the bed is 16,990 square miles. This sheet is the basis of estimates of the amount of coal originally contained (1,032,000,000 tons), in the area which has been exploited (92,189,000 tons), and of the amount which has been actually removed from this area (54,116,000 tons).

COUES-STEARNS' NEW ENGLAND BIRD LIFE.[1]—With the completion of the second volume of this work, the incipient or the

[1] *New England Bird Life.* Being a manual of New England Ornithology. Revised and edited from the manuscript of WINFRED A. STEARNS by ELLIOTT COUES. Par. II. Non-oscine Passeres, birds of prey, game and water Birds. Boston, Lee & Shepard; New York, Charles T. Dillingham. 1883. 12mo, pp. 409.

advanced ornithologist of the Eastern States is provided with the latest and most complete epitome of the subject which he could wish for. Indeed it will now, we should think, be a difficult problem for the ornithological book maker to know how to plan another book at all original, either in scope or treatment. What between keys, check lists, manuals and ornithological biographies, the field of avian biology has been pretty well covered, although not entirely. We yet need, we think, elaborate, detailed, circumstantial bird lives; we require the results of more prolonged field studies. For example, we have been unable to find in a number of books at hand, how long the robin is engaged in building its nest, just when its eggs are laid, etc.; the book before us does not state whether the kingfisher uses the same hole year after year. Questions of this sort put to us by an incipient ornithologist of eleven years, we cannot answer from the books at hand. Moreover many of our ornithologists are boys from ten to sixteen years of age; they do not find even in books like the present such details of bird life as are suggested above, and on the other hand they are repelled here and there by hard words, words which we sometimes cannot explain to them. Technical expressions and words which save but a few letters or syllables should in such books as the present be substituted for more round-about but comprehensible expressions. The boy's book of birds has therefore yet to be written, and perhaps this will be the next ornithological book to be offered to the public.

Yet with its slight shortcomings the present is a most admirable, fresh manual, and will for many a day lead the list of our semi-popular ornithological books. It is handy, compact and reasonable in price, well printed and tolerably well illustrated.

The work describes both the land and water birds, and represents the entire bird fauna of New England.

LATE WORKS ON EVOLUTION.[1]—Books and pamphlets on this prolific theme are multiplying, and authors, both amateur and expert, treat it from biological, metaphysical and theological standpoints. Amid much diversity, there is a general agreement in the sentiments of the authors whom we quote below, in their dissatisfaction with the bald Darwinism of Tyndall, and the one-

[1] *The Theories of Darwin and their relations to Philosophy, Religion and Morality.* By RUDOLF SCHMID, president of the Theological Seminary at Schonthal, Wurtemburg. Chicago, Jansen, McClurg & Co.

Final Causes. By PAUL JANET. New York, Chas. Scribner's Sons, 1883. Translated from the second edition of the French, by William Affleck, B.D.

A Critique of Design-arguments; a historical review and free examination of the methods of reasoning in Natural Theology. By L. E. HICKS. New York, Chas. Scribner's Sons, 1883.

Development, what it can do and what it cannot do. By JAMES MCCOSH, D.D. New York, Chas. Scribner's Sons, 1883.

Natural Selection and Natural Theology, a discussion between Dr. Romanes and Dr. Asa Gray in *Nature*, Vol. XXVI, 1883.

sidedness of Haeckel and his imitators. This sentiment has found expression in both England and America by strong advocates of organic evolution, who find natural selection insufficient to account for the existing characters of living beings. Some, like A. W. Bennett and the botanists generally, have contented themselves with objecting. Zoölogists, who are more familiar with the effect of motion on structure, seek for the "origin of the fittest" with greater hope of result, and it is among this class that the hypothesis of the origin of structure by "use and effort" has been chiefly advocated. Darwin himself never grasped this side of the evolution question, as may be seen in the following extracts from a letter of his to the *Spectator* (London) of Jan. 11, 1873:

"SIR:—Any one interested in the subject to which you allude at p. 42 of your last number, namely, the relative importance in causing modifications of the body or mind, on the one hand of habit or of the direct action of external conditions, and on the other hand of natural or artificial selection, will find this subject briefly discussed in the second volume (pp. 301–315) of my 'Variation of Animals and Plants under Domestication.'

* * * * * * * * * *

"I have made many observations and collected many facts showing the potent influence of habit and of the use or disuse of parts on organic beings; but there are numberless peculiarities of structure and of instinct (as in the case of sterile neuter insects) which cannot be thus accounted for. He would be a bold man who would attempt to explain by these means the origin of the exsertile claws and great canine teeth of the tiger; or of the horny lamellæ on the beak of the duck, which are so well adapted for sifting water. Nor would any one, I presume, even attempt to explain the development, for instance, of the beautifully plumed seeds of the dandelion, or of the endless contrivances which are necessary for the fertilization of very many flowers by insects, through gradually acquired and inherited habit, or through the direct action of the external conditions of life."

Now, it is precisely what Mr. Darwin here declares to be so difficult that the *causal evolutionists*, as distinguished from the *selective evolutionists*, set themselves to accomplish. That is, firstly, to show that in the case of animals and plants incapable of movements of their own, their structure has been modified in descent by the influences of their environment, while in the case of those beings that can move, modification is the combined result of the mutual interaction of the organism and its environment together. Since the general result displays adaptation, the causal school must ultimately discover whether it be intelligence which is thus displayed or not, and if so, whence it proceeds.

The botanists are here in a greater dilemma than the zoölogists, but the extraordinary discoveries of the relations of insects to plants, bid fair to extricate them from their difficulty.

Of course the theologians, who chronologically follow the scientists at a safe distance, are now in the Darwinian woods, and are trying to hew a way out. The question with Messieurs Janet and Hicks is, not whether evolution be true, they accept this latest dictum of science, but whether it be a result of design as indicated by the causal school, or by chance, as follows from the teaching of the selective or Darwinian school. On the truth of the former doctrine depends the belief in intelligent creation. The latter form of doctrine cannot admit of any such origin of things, for, as Huxley has said, "teleology, as commonly understood, has received its death-blow at Mr. Darwin's hands." Of course the theologists, anxious to preserve and demonstrate the doctrines of theism, seek for proof of design in evolution. This leads them at once into conflict with Darwinism.

The works of Janet, Schmid and Hicks are what one might term theologico-philosophical or philosophico-theological. They agree in their general inefficiency and inadequacy in dealing with the phenomena of the actual world. They display little or no knowledge of the sciences on which the principles of evolution rest, viz., embryology and palæontology. This being true, a good deal of space appears, to the critical reader, to be occupied with unnecessary and feeble discussion of the subject. Thus Schmid tells us there are four theories of creation, viz., by selection, by evolution, by descent, by direct creation! He sustains the third of these supposed distinct doctrines. We think Dr. Schmid's book the weakest of the three, and a person who desires to have any clear idea of the doctrine of evolution had better avoid it.

Janet's work is an abler production. It is a prolonged investigation of the probabilities of the truth of the teleological and antiteleological schools of evolution. Probably had the writing of the work been postponed to the present time, the learned author would have materially altered his views as to the nature of the evidence obtainable, and would have discovered that there are two totally distinct kinds of teleology. He opposes the Darwinians, using Bennett's effective arguments against "omnifarious variation," but he sustains the untenable position of Milne Edwards respecting the nature of the animal mind.

Professor Hicks has written a polemical work in support of theism by a doctrine which he calls eutaxiology. He distinguishes it from teleology, as expressive of the general order of the universe; the latter being defined as the law of foreordination of means to definite ends in creation.

The attitude of Dr. McCosh towards natural science has always been liberal, and he has greatly aided the theological world in understanding the doctrine of evolution. He, too, is an objector to pure Darwinism, but has no scientific hypothesis to offer in its stead. His strongest objections are directed against the experimental and derivative hypothesis of the evolution of mind. He

insists on the intuitive origin of some of the higher mental faculties. In this we cannot follow him. His pamphlet is written in a fair and conciliatory spirit.

To one who may desire to see the views of two of the advocates of the originative and selective schools of evolution set forth, we recommend the reading of the discussion between Dr. Asa Gray and Mr. Romanes which appeared in *Nature*, closing with the number of May 24, 1883. We quote the following words from Dr. Gray, which repeat essentially the views expressed by Dr. Bennett and ourselves[1] at various times:

"I take Dr. Romanes now to agree with me that the physical distinction of the less fit organism, or, more generally, that the action of the environment, is not in a proper sense the cause of the advantageous variations of surviving organisms; also that natural selection does not explain and has no call to explain the cause of variation. As to this, he says, the theory merely supposes that variations of all kinds and in all directions are constantly taking place, and that natural selection seizes upon the more advantageous. Now, if variation in animals and plants is lawless, of all kinds and in all directions, then no doubt the theory of natural selection may be 'the substitute of the theory of special design,' so as to efface that evidence of underlying intelligence which innumerable and otherwise inexplicable adaptations of means to ends in nature were thought to furnish. If it is not so, then the substitute utterly fails. For omnifarious and purely casual variation is essential to it in this regard. Fitly is it said that 'the theory merely supposes' this. For omnifarious variation is no fact of observation, nor a demonstration, or, in my opinion, even a warrantable inference from observed facts. It is merely an hypothesis, to be tried by observation and experiment." * * "But there is no evidence that all sorts of varieties ever appeared or tended to appear, and there is a musty maxim about 'de non apparentibus et de non existentibus,' which is not devoid of application." * * "The upshot is, that so far as observation extends, it does not warrant the supposition of omnifarious and aimless variation, and the speculative assumption of it appears to have no scientific value."—*C.*

VIALLANES' HISTOLOGY AND DEVELOPMENT OF INSECTS.—This laborious work occupies 348 pages, indeed forming nearly an entire volume (XIV) of the Annales des Sciences Naturelles. It is illustrated by eighteen excellent, sharply-drawn, lithographic plates. Besides the purely histological treatment, M. H. Viallanes, inspired by the epoch-making work of Weismann, has made a detailed study of the histological phenomena which accompany the post-embryonic development of insects.

The work is divided into three parts. The first comprises a

[1] NATURALIST, 1882, p. 457.

study of the tissues of the fully-grown larva and imago, including the teguments of the larva, and its peripheral nervous system and sensitive nervous terminations, its involuntary and voluntary striated muscles, as well as the motor nervous terminations in the voluntary striated muscles. The second part is devoted to a study of the phenomena of histolysis or destruction of the larval tissues, with especial reference to the muscles, fat-body, salivary glands and tracheæ, with a chapter on the desiccation and disappearance (chute) of the larval hypodermis. The third part comprises a study of the phenomena of histogenesis, or formation of the tissues and systems of organs of the imago, including the development of the teguments of the head and of the thorax and abdomen, likewise the development of the muscles, and of the eyes.

The work has been evidently prepared with thoroughness, and is the most important contribution of the year to the histology and metamorphosis of Arthropoda.

CASSINO'S INTERNATIONAL SCIENTISTS' DIRECTORY.[1]—This book is, in its present form, well arranged, and is both useful as a domestic and foreign scientific directory. The names are arranged in alphabetical order, and the American addresses are not arranged as in some of the earlier editions very inconveniently by States. We notice some omissions of importance in the German and Austrian portions, but when it is taken into account that there are in all upwards of 17,000 or 18,000 addresses of naturalists living in nearly every country under the sun, any fault-finding for sins of omission or commission are scarcely in place. The number of addresses of scientists, including amateurs, living in the United States and Canada, we should roughly estimate at about 5500; in Great Britain about 3000; in Germany 1800 (probably the number should be doubled or trebled); in Austro-Hungary 1000; while there are about 2000 French addresses. A directory of the scientific societies of the United States and Canada is added; they number about 200.

This directory is of great and constant use, as facilitating intercourse between scientific as well as amateur observers of our own and of different countries.

KUNCKEL D'HERCULAIS' ORGANIZATION AND DEVELOPMENT OF DIPTERA.[2]—This magnificent work, for such it truly promises to be when completed, should be at least introduced to the notice of

[1] *The International Scientists' Directory.* Containing the names, addresses, special departments of study, etc., of amateur and professional naturalists, chemists, physicists, astronomers, etc., in America, Europe, Asia, Africa and Oceanica. Compiled by SAMUEL E. CASSINO. Boston, S. E. Cassino & Co. 1883. 12mo, pp. 299.

[2] Recherches sur l'Organization et le Développement des Diptéres et en particulier des Volucelles de la famille des Syrphides. Par JULES KUNCKEL D'HERCULAIS. Folio with numerous plates. Paris, 1875–'81.

our entomological readers. Beginning with the transformations and anatomy of a single genus, the author in the second part has extended his studies to the anatomy of other Diptera, until the work promises, from what has already appeared, to be a worthy successor of those of Straus-Dürckheim, Lyonnet, Newport and Weismann.

Part first appeared in 1875, and received the grand prize of the physical sciences given by the French Academy of Sciences. It treats of the habits, tegumentary system and its development, and the muscular system and its development of Volucella.

Only the atlas of the second part has as yet been published; it comprises Plates XII–XXVI. The more notable figures are those illustrating the nervous system of various Diptera, the longitudinal sections of the adult Volucella, with three enlarged views, representing in one the heart, etc., in another the tracheæ and air-sacs, and in a third figure the digestive and nervous systems. The enlarged longitudinal section of the head and proboscis of Volucella is especially valuable and noteworthy. There are also numerous figures of microscopical sections. The plates have been mostly engraved on steel by Lebrun.

PUTNAM'S SOLPUGIDÆ OF NORTH AMERICA.—This posthumous essay on the family of Solpugidæ forms the concluding portion of the third part of the third volume of the Davenport Academy of Natural Sciences, issued in memory of Joseph Duncan Putnam, late president of the academy. The brochure contains the memorial meeting in honor of Mr. Putnam, biographical sketches by Dr. C. C. Parry and by Mr. W. J. McGee, with resolutions passed by the Iowa Academy of Sciences and other societies, all testifying to the scientific and moral worth of the young naturalist.

The notes and articles on the Solpugidæ were designed to form the materials for a monographic account of this interesting group of Arachnida, which occur in great rarity in North America, specimens being hard to obtain. The literary materials have been arranged by Mr. H. Osborn, and comprise general notes concerning the family and its genera; descriptions of new, and notes and comparisons of known species, a list of North American species, naming the collections in which they are preserved; extracts from the notes and correspondence relating to the group, and a bibliography. The work was done with great thoroughness by Mr. Putnam, the description being detailed and comparative, and the notes of habits and distribution very full. The drawings of these difficult subjects made by Mr. Putnam evince unusual artistic skill and patience. The new species described are *Datames striatus* Putn., *D. girardii* Putn., *D constricta* Putn., *D. dilatata* Putn., *D. cinerea* Putn. No better work has been done in descriptive arachnology, and had Mr. Putnam lived he would have been an acknowledged authority as a zoölogist in whatever department he might have chosen to work.

BREWER ON THE AMERICAN TROTTING-HORSE.[1] — Professor Brewer treats of the American trotting-horse as a breed in process of formation. Prior to the present century it was the racer that was valued; the draught-horse was but a slave. Representations of horses on Egyptian, Ninevite, Greek and Roman remains show no trotting-horses, and the forms of the animals prove that their racers could not compare in speed with modern ones.

With the improvement of roads, more attention was given to the horse as a beast of draught, and various causes combined in this country to bring about that love for a quick trotting-horse which has produced such remarkable results. Among these causes are fashion—the existence of a class with whom it was fashionable to drive one horse before a light carriage. This fashion was to a great extent created by the laws against racing that were enacted through the puritanic prejudices of the settlers. To trot one horse against time was not *racing* in a technical sense. Other causes were improvements in wagons and the invention of steel springs; the possession of hickory to make light wagons of, and the necessities of modern travel.

The American trotting-horse is a cross between the English thoroughbred and the common stock of the country, which last is a mongrel derived from English, French, Dutch and even Swedish and Spanish sources.

LECTURES TO THE EMPLOYEES OF THE BALTIMORE AND OHIO RAILWAY.[2] — These clearly-written lectures may be read with profit by many others besides those for whom they were specially prepared, and among whom, through M. Garrett, the president of the road, the printed copies are distributed gratis. In the first, "How Skulls and Backbones are built," Dr. H. N. Martin passes in review the principal features, especially the protective uses, of the vertebrate skeleton; in "How we Move," Dr. Sewall explains in easy English the action of nerve and muscle; "Fermentation" is the subject of Dr. Sedgwick; and Dr. Brooks treats of the locomotive methods of some invertebrate animals.

Lectures such as these, on scientific subjects, or on art or history, themselves part of social science, would do more, in able hands, to close saloons and put down the coarser forms of vice than all the repressive measures that can be enacted. What all men (and women) need is recreation, and in some shape or other they will get it. Whoever provides a recreation of higher grade than that previously indulged in by the class it appeals to, is a benefactor of society.

[1] *The American Trotting-horse*, Why he is and What he is. By Professor W. H. BREWER. Ext. from the report Conn. Board of Agriculture. Also The Evolution of the American Trotting-horse. Ext. Amer. Jour. Sci. April, 1883.

[2] *Lectures delivered to the Employés of the Baltimore and Ohio Railway*, by Professor H. N. MARTIN and Drs. H. SEWALL, W. T. SEDGWICK and W. K. BROOKS, of the Johns Hopkins University. Baltimore, 1882.

BULLETINS OF THE U. S. DEPARTMENT OF AGRICULTURE.[1]—Bulletin No. 1 contains reports of experiments, chiefly with emulsion of kerosene, upon various insects that injuriously affect the orange tree and cotton plant. These kerosene emulsions appear to be to a great extent successful, both against scale insects and the cotton-worm.

According to Bulletin No. 2, *Caloptenus spretus*, the Rocky Mountain locust, was generally scarce in 1882, so much so that Western farmers have little to fear from it during the present year.

Professor S. A. Forbes has experimented with emulsion of kerosene upon the chinch-bug with good results. He finds that soapsuds (1 lb. soap to 10 galls. water) mixed with an equal quantity of oil, make a good emulsion, so that the addition of milk is not necessary. These fluids accomplish their work as well when poured on with a sprinkler as when applied forcibly in a spray, and kill the adult bugs as easily as the young.

RECENT BOOKS AND PAMPHLETS.

Hayden, F. V., and Selwyn, A. R. C.—Stanford's Compendium of Geography and Travel. North America. Edward Stanford. London, 1883. From Dr. F. V. Hayden.

Dollo, M. L.—Troisième note sur les Dinosauriens de Bernissart. Ext. du Musée Royal d'Histoire Naturelle de Belgique. 1883. From the author.

Lewis, H. C.—The great Ice Age of Pennsylvania. Reprint from Journal Franklin Institute, April, 1883.

——The Geology of Philadelphia. Reprint idem, June, 1883. Both from the author.

International Geological Commission.—Reports of Sub-committees. Permian and Trias, by A. Irving. Miocene and Eocene, by J. S. Gardner. Pliocene and Post-pliocene, by H. B. Woodward. From the commission.

Minot, C. S.—Is Man the highest Animal? Ext. Proc. Amer. Assoc. Advancement of Science, 1881. From the author.

Hughes, T. McKenny.—Memoir E. B. Tawney. Ext. Geol. Magazine, March 1883.

——On the relation of the appearance and duration of the various forms of life upon the earth to the breaks in the continuity of the sedimentary strata. Ext. Proc. Cambridge Philosophical Society. Both from the author.

Putnam, F. W.—Notes on copper implements from Mexico. Ext. Proc. Amer. Antiquarian Society, Oct. 21, 1882. From the author.

Hoffmann, C. K.—Dr. H. G. Bronn's Klassen und Ordnungen des Thier-reichs. Reptilien. Leipzig und Heidelberg, C. F. Winter.

Kansas Academy of Science.—Transactions, Vol. VIII, 1881–82. From F. H. Snow.

Clevenger, S. V.—Plan of the cerebro-spinal nervous system. Ext. from Rep. Boston Meeting of the Amer. Assoc. for the Advancement of Science, Aug., 1880. From the author.

Lemoine, V.—Etude sur le Neoplagiaulax de la faune Eocène inférieure des environs de Rheims. Ext. du Bulletin de la Société Géologique de France, Fevrier 12, 1883. From the author.

Renevier, E.—Unification Géologique. Propositions du Comité Suisse aux Commissions Internationales. Ext. Archives des Sciences Physiques et Naturelles Genève, Mai, 1883. From the author.

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[1] *U. S. Department of Agriculture.* Division of Entomology. Bull. Nos. 1 and 2. C. V. RILEY, entomologist.

Terquem.—Cinquième Mémoire sur les Foraminifères du système Oolithique. From the author.

Guyot, A.—Louis Agassiz. A Biographical Memoir. Read before the National Academy, 1877–78. Princeton, N J., 1883. From the author.

Scott, W. B., and Osborn, H. F.—On the skull of Orthocynodon.—

Osborn, H. F.—On Achænodon, an Eocene Bunodont.—

Bruce, A. T.—Observations upon the brain casts of Tertiary mammals.—

Scott, W. B.—On Desmatotherium and Dilophodon, two new Eocene lophiodonts. Contributions from the E. M. Museum of Geology and Archæology of Princeton College, Bulletin No. 3.

Ryder, J. A.—On the mode of fixation of the fry of the Oyster. From the author.

Goode, G. B., and Bean, T. H.—Bulletin of the Museum of Comparative Zoölogy at Harvard College. Reports on the results of dredging, under the supervision of A. Agassiz, on the east coast U. S. XIX. Report on the Fishes. From the authors.

Lydekker, R.—Synopsis of the fossil Vertebrata of India, and Note on the Bijori Labyrinthodonts. Ext. Records Geol. Survey of India, 1883. From the author.

——Palæontologica Indica. Series X. Indian Tertiary and Post-tertiary Vertebrata. Vol. II, Pt. 4. Siwalik Camelopardidæ. Calcutta, 1883. From the author.

Hulke. J. W.—An attempt at a complete osteology of *Hypsilophodon foxii*, a British Wealden Dinosaur. Ext. Philos. Trans. of the Royal Society, Part III, 1882. From the author.

——Address delivered at the anniversary meeting of the Geological Society of London, Feb. 16, 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—A journey undertaken by F. C. Selous in the Mashuna country, lying between the Matabele settlements and the Zambesi, has resulted in a considerable addition to our knowledge of this region. The great mountain chain of Umvukwe, running north-east to south-west forms the water-shed—all streams rising on its north-western side flow into the Zambesi, while those issuing from its south-eastern flanks must run into the Mazo. A series of high and rugged ridges run in an east and west direction from the western flank of the Umvukwe mountains, and between these ridges flow the Umquasi, Mutiki, Mabane, Umpinge and Dande, all tributaries of a large river flowing northward into the Zambesi, and called the Panyame, Manyame or Hanyane. This river, which on other maps is shown as joining the Zambesi west of the town of Zumbo, is by Mr. Selous stated to enter fifteen miles at least to the east of that place. Between the ridge that bounds the valley of the Dande to the north, and the Zambesi, is a nearly flat and very dry district covered with *mopani* forests. In crossing this dry belt the Panyame and its tributaries as well as the Umsengaisi, which flows into the Zambesi about a degree further to the east, become broad-bedded sand-rivers

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

with little or no water. These lowlands swarm with Tsetse flies. The Umsengaisi is the Zingesi of the map of the Royal Geographical Society.

The delta and lower course of the Sabi river, which enters the Indian ocean about 21° S. lat., has been correctly surveyed, but at the cost of the lives of Capt. T. L. Phipson-Wybrants, the leader of the party, and of Dr. Ward Carr, F.G.S. The lower district, called Machanga, is occupied by the Tongas, subjects of Umzila, whose kraal is about 250 miles farther westward. The district around the Sabi, when the higher lands are reached, is exceptionally fertile.

The Thomson expedition is safe. Mr. Thomson left Bura, 100 miles from Mombasa, for Taveta, at the south-eastern foot of Kilimanjaro, on March 29th.

The Ma-Gwamba, or "Knobnoses," as the Boers call them, living north and south of the Limpopo, are by Pasteur Berthoud stated, from linguistic evidence, to be of Zulu stock, and thus not related to the Chuana. These Gwamba consider Umzila and his people to be Zulu also, and the Ba-Tonga are stated to be akin to the Gwamba. The Gwamba language is a sister of the Zulu. If Berthoud's statements are true, the tribe is one of great numerical importance.

Herr Pechuel-Loesche, who has served for some years as second in command to Stanley, has given a clear description of the mountainous belt, 200 miles wide, which shuts the Upper Congo from the coast. This range is of Cambrian age, and of slight elevation, averaging 700 to 1000 feet in height, and only here and there reaching 3300. It consists of numerous parallel ridges, between which run affluents of the Congo, which is the only stream of the region that cut across the entire system. Thus the Congo runs in a ravine the whole way, and its bed has a fall of 928 feet in about 300 nautical miles. Throughout this distance dangerous rapids abound, but the only vertical fall is Isangila, which is only sixteen feet high, and does not occupy the entire width of the stream. Some of the mountain brooks have cut their courses down to the level of the main river, but other larger rivers that flow over horizontal strata enter by a cataract. Thus the Luenga falls from a height of more than 300 feet, and the Luvubi from 500 feet. The Congo rises from September to January, and again in April and May (the rainy season) when the waterfalls disappear under the swollen waters.

The summits of the mountains are rounded and covered with grass and small bushes, but the valleys contain forests of lofty trees. Further to the north is the great forest of Tschiyombe.

Dr. Pechuel-Loesche states that the "Makoko" from whom De Brazza claims to have obtained a section of the Congo region, is certainly nothing more than a local chief. Makoko simply means "the ruler of the stream," and there are several. One is

the trusted friend of Stanley, and sold him a large tract of land, and the others are only similar kinglets ruling small districts.

M. Mosionas claims to have discovered the descendants of the people from whom the ancient Egyptians sprung. This honor he attributes to the Hadendoas, a tribe of the Egyptian Soudan. He maintains that he has found among them evident traces of the language, manners, customs and beliefs of ancient Egypt.

Dr. Bayol's scientific mission in Senegal has resulted in the discovery of a forest of ebony trees six miles in extent, and of forty-five wood essences.

AMERICA.—Mr. A. P. Maudslay recently read before the Royal Geographical Society an account of his investigations among the ruined cities of Guatemala. He visited Quirigua, where he discovered several fine monoliths; Copan, where a monolith covered all over with hieroglyphics in low relief has lately been unearthed; Tikal, a town about twenty miles from Lake Peten, and previously visited only by Bernouilli; and Usumacinta, a hitherto unknown place. At Tikal are five great pyramidal temples, and many houses of stone with stone roofs. Many of the lintels of the doorways are elaborately carved. Usumacinta is smaller, and the houses differ from those of Tikal in having their interiors broken up into recesses by inside buttresses that support the roof, which spans a wider area, and by the employment of stone instead of sapote wood for the lintels, many of which are carved.

Captain C. E. Dutton is organizing his forces for a summer campaign in the Cascade range, from Mt. Shasta to Mts. Hood and Ranier, a region which contains possibly the most colossal outpour of volcanic matter in the world.

Dr. L. Stegneger contributes to *Naturen* an interesting account of the Kommandorski islands, which form the western group of the Aleutian archipelago. One of these is named after Bering, whose shipwreck and death occurred there; the other is Mednoj. Ostrov, or Copper island, from the large amount of pure copper found there. The islands consist generally of deep narrow valleys separated by rocky heights of from 1000 to 2000 feet, and are geologically allied to Kamschatka, except at the north of Bering's island, where raised beaches and terraces have been left by the subsidence of the sea. A Russo-American fur company is established here. The vegetation is stunted and sparse, presenting a great contrast to that of Kamschatka, which, spite of its position, has an exuberant growth of birches, alders, willows, wild roses, rhododendrons, lilies, etc., far excelling that found in Norway, as also an enormous variety of birds, including "*Acrocephalus dybowskii*," a sedge-warbler, *Locustella lanceolata*, which possesses a grasshopper-like cry, a cuckoo, pipits, chats and wagtails.

Dr. Otto Finsch states that the Gilbert or Kingsmill islands,

consisting of eighteen atolls, and with an area of only twelve square miles, contain 37,000 inhabitants, while the Marshall group with thirty-five square miles, distributed among thirty atolls, has only 10,000. Four thousand ethnological specimens, illustrating the lives of these islanders and of those of New Britain, have been collected by this traveler, also some interesting prehistoric remains from Ponapé, one of the Carolines, many skulls and a very large collection of vertebrates and invertebrates.

The Marshall islanders are rapidly losing their ancient customs, and Herr Finsch believes that the great sea canoe, which he has brought away, will soon be the last of those with which this people, though without nautical knowledge, won repute as mariners and undertook long journeys. European skiffs will soon supersede them.

The people of the Gilbert islands retain more of their original manners than those of the Marshall islands.

The Maneap or assembly house of Butaritari, one of this group, is 250 feet long by 114 wide; dimensions which are remarkable in a structure held together by cords of cocoa-nut fibers.

ASIA.—The six hundred thousand square miles contained in Persia form a plateau roughly averaging from three thousand to five thousand feet above the sea, and the entire region, according to Col. Champain, is not only very poorly provided with means of communication, but must ever remain difficult of access on account of its intersection by numerous barren mountain ridges. The only fertile spots, some wondrously productive, are the valleys between these ranges. The Russians are improving their communications with this country to a considerable extent, as a regular line of steamers plies between the Volga and the Persian ports of the Caspian, between which and Tehran run almost the only good roads in the country.

The changes of level of the Caspian puzzle geographers. It has risen and fallen at irregular intervals since 1780, but was ten feet lower in 1830 than in 1780. Lenz made permanent marks at Baku in 1830 at the sea level, but the oscillations since that date have shown no sensible decrease. On May 30, 1853, the level was 2 ft. 1.3 in. lower than in March, 1830, but in September, 1854, the high-water level was 1½ ft. above that of May 30, 1853, and on June 4, 1882, it was 10½ in. higher than in 1830.

M. Yadrintseff states that throughout Northern and Middle Siberia the aborigines are decreasing in number, although this is not the case with the Tartars of the south, who have kept their pasture lands. The Tartars of Middle Siberia, once a class of privileged merchants, are decreasing, and are among the poorest of the population. The Ostyaks and Samoyedes are in a miserable condition.

From a paper by M. Smicroff, published in the *Izvestia*, it is evident that the climate of the Caucasus is quite continental. The average annual mean temperatures are 5° 4′ Cels. at Alexanderpol, 8° 5′ at Stavropol, 12° 6′ at Tiflis, and 14° 3′ to 14° 5′ at Bakou, Lenkoran, Kutais, Poti, and Redut-kaleh, but the yearly range of the average diurnal temperature is in most cases from 20 to 30°. The highest temperature observed was 38° 5′ at Tiflis, the lowest —25° 6′ at Stavropol. It is only in Southern Transcaucasia that localities are found where the temperature does not fall below —10°. The southern limit of the region beyond which temperatures lower than —20° are not found runs from the Crimea to the Caucasus range, and along the northern slope of the last towards Khiva, Tashkend, and Peking. The greatest range of temperature observed was 60° 4′ at Stavropol, while at Redut-kaleh it is reduced to 41° 6′. Large though this range is, it is small compared with that of Yakutsk, which varies from +38° 8′ in summer to —62° in winter.

M. Balkashin, in the *Izvestia*, concludes that the Kirghiz are a federation of several nomad tribes that formerly ranged from Southern Russia to Lake Baikal, and were mingled together by Genghiz Khan and his successors.

M. Grigorieff, in the *Izvestia*, shows that Henriette island is the land sighted by Hedenström and Sannikoff from New Siberia in 1810, and that Bennett island was seen by Sannikoff from the northern coast of New Siberia in 1811. Thus the discoveries of the ill-starred *Jeannette* are reduced to *nil*.

GEOLOGY AND PALÆONTOLOGY.

A NEW PLIOCENE FORMATION IN THE SNAKE RIVER VALLEY.—In 1870 the Smithsonian Institution submitted to me for determination a series of specimens of fishes which had been obtained by Mr. Clarence King, then in charge of the U. S. Geological Survey of the 40th parallel, in the south-western part of Idaho Territory. As a result of my examination I published descriptions of eleven species of fresh-water fishes,[1] and three of Astaci. The first specimens derived from this formation were sent by Dr. J. S. Newberry to Dr. Leidy, who described two species of fishes. Subsequently Professor Condon, of the University of Oregon, discovered the formation with some of its fossils on Willow creek, in Eastern Oregon, fifty miles north-west of the original locality. In 1880 I sent Mr. J. L. Wortman to this region, and he obtained twenty-two species from these and other localities, of which ten were new to science. He also procured bones of two species of

[1] On Cretaceous and Tertiary Reptilia and Fishes, by Professor E. D. Cope, November, 1870, Proceedings Amer. Philos. Society.

Mammalia. The following list shows the character of the fish fauna:

Percidæ	1	species.
Cottidæ	4	"
Salmonidæ	1	"
Cyprinidæ	11	"
Catostomidæ	2	"
Cobitidæ	1	"
Siluridæ	1	"
Raiidæ	1	"
Total	22	"

Of the above, all differ from existing species so far as known, but three of the species which represent the Percidæ, the Cobitidæ, and the Siluridæ, respectively, have not been exactly determined. All the species differ from those of the Oregon lake (or Lake Lahontan as it may prove to be). Of the families, all are existing, and all are represented on the North American continent excepting the Cobitidæ, which are now confined to Eurasia.

But of these eight families four are not now found in the American waters which empty into the Pacific ocean, viz., the Percidæ, Siluridæ, and Cobitidæ and Raiidæ, excepting that there is one species of the Percidæ in California. Five of the seven families have not yet been found in the Oregon fossil lake basin, but as two of them (Salmonidæ, Cottidæ) are found in the existing lakes of that region, they will probably be found in that deposit.

The above evidence is sufficient to prove that the Idaho Pliocene formation is distinct from any formation previously known, and that it is older than the Oregon lake deposit.

In addition to the fishes, three species of crayfishes were discovered in this formation by Capt. Clarence King. These I named[1] *Astacus subgrundialis*, *A. chenoderma*, and *A. breviforceps*.

The mollusks of this formation have been described by F. B. Meek, and they, like the fishes, determine it to be lacustrine and fresh, as already stated by Professor Newberry. The species are stated by Meek[2] to be distinct specifically, and in some cases generically, from all others hitherto described from the West. Leidy observes[3] that Mammalian remains received from Capt. King's expedition include portions of *Mastodon* and *Equus excelsus*.

Mr. Wortman obtained teeth and bones of the latter, and a cannon bone of an undetermined ruminant of the size of the *Cervus elaphus*.

The ungual phalange of an edentate allied to Megalonyx was obtained from the same horizon and locality.

Mr. Wortman informs me that the bone bed is sandy, and is both overlaid and underlaid by clay rocks of little hardness. The formation covers several hundred square miles in this body.—*E. D. Cope.*

[1] Proceedings Amer. Philos. Society. 1870, p. 605. Loc. cit., Nov., 1870.
[2] Proceedings Acad. Nat. Sci., Phila., 1870, 56.
[3] L. c., 1870, 67.

THE "THIRD TROCHANTER" OF THE DINOSAURS.—M. L. Dollo has recently instituted a comparison between the trochanters upon the femur of Iguanodon and those of Anas, Bernicla and Cygnus, and announces his conclusion that the so-called "third trochanter" of the former (and of other Dinosaurs) is found also in the avian genera mentioned. The great resemblance between the dinosaurian and avian femur was noted by Huxley in 1870, and has been generally admitted, but the absence, in most birds, of the third trochanter, which is so conspicuous a crest in Iguanodon, has been a difficulty.

M. Dollo figures, side by side, the femur of *Cygnus atratus* and that of *Iguanodon bernissartensis*, and the proof is evident that the bird possesses the same trochanter—the position is the same, the form very similar, but the size relatively far inferior.

Dissection proved that the duck's third trochanter serves for the insertion of the caudo-femoral muscle, which, as shown by Meckel, is the agent in the curious lateral movements made by the tail of the duck; and also for the insertion of the ischio-femoral muscle.

The difference in the relative dimensions of the trochanters is, therefore, correlated with the difference in size of the tails of the two animals. The enormous tail of the Iguanodon needed for its movement a massive muscle, instead of the thin slip present in the duck and swan.

Hesperornis, a bird so reptilian in many respects, ought, therefore, to have this trochanter, and M. Dollo remarks that although Professor Marsh did not note its significance, it is plainly shown in Plate XIII of that author's work on the Odontornithes.

This trochanter cannot be homologized with either of the three trochanters found in mammals, since it serves for the insertion of a totally different set of muscles from those attached to either of them, and M. Dollo therefore proposes to distinguish it as the "fourth trochanter."

THE PUERCO FAUNA IN FRANCE.—Dr. Lemoine has published the second part of his Researches on the Fossil Birds of the Inferior Tertiary of the neighborhood of Reims. In an introduction he distinguishes the two faunæ of the north of France, which represent the beginning of the Tertiary, the Cernaysienne and the Suessonienne. These correspond with remarkable equality to the Puerco and the Wasatch faunæ, which I discovered on this continent. Not a few of the genera are common to the two continents, but the extent of the identity cannot be fully understood in the present state of our knowledge of the respective forms. Those of the Cernaysian fauna, as given by Lemoine, are the following: *Mammalia:* Heteroborus, Hyodectes, Hyænodictis, Lophiodochœrus(?), Pleuraspidotherium, Plesiadapis, Adapisorex, Ptilodus; *Reptilia:* Champsosaurus, crocodiles, turtles and Lacer-

tilia; *Aves: Gastornis edwardsi, Remornis heberti, Eupterornis remensis* Of the above, two genera, Ptilodus and Champsosaurus appear to be absolutely identical in France and New Mexico; some of the others have near allies in New Mexico, but of identity there is not yet certain evidence.

In Europe, as in America, the Suessonian epoch ushers in the genus Coryphodon. Hyracotherium also appears (*Pachynolophus gaudryi* Lem., is a Hyracotherium), and Pliolophus. A number of other genera are probably identical in North America and France, as Miacis, Opisthotomus, Phenacodus, and Pantolestes, with Lophiodon and Dichobune, not yet found in America. Hyænodictis and Plesiadapis hold over from the Cernaysian fauna.

Uniformity of nomenclature requires that the Suessonian, introduced by D'Orbigny, should replace the name Wasatch, which was given by Hayden many years later.[1] In like manner the Cernaysienne of Lemoine is identical with the Puerco of Cope, and the latter name has six or seven years priority. So also the genera Ptilodus[2] and Champsosaurus[3] were named first in America.

The genus Gastornis proves to be one of the most remarkable which palæontology has brought to light. It is the only bird known, in which the cranial sutures are persistent, and it has indications of a tooth in the position of the canine of the Mammalia. It is nevertheless a true carinate bird with reduced wings and complete tarsometatarse. The height of the *G. edwardsi* is about two and a half meters.

Note.—Since the above was written a well illustrated paper from the Bulletin of the Geological Society of France has come to hand, which describes the species of Neoplagiaulax Lem. The type, *N. eocænus*, differs from the *Ptilodus mediævus* in lacking the third premolar tooth from the lower jaw.—*E. D. Cope.*

MINERALOGY.[4]

EMPHOLITE, A NEW MINERAL.—M. L.-J. Igelström[5] has recently described a new mineral from Hörrsjöberg, Sweden, which, occurring in minute, generally microscopic crystals, has received the name empholite, from ἐμφωλεύω, to hide.

The crystals are white, transparent, and very brilliant, having a hardness of 6 or over, and belonging to the orthorhombic system. They have an easy cleavage parallel to the crystallographic

[1] See AMERICAN NATURALIST, 1877, p. 95.

[2] This genus was described in the NATURALIST for Nov., 1881 (published October 28). The first description of the genus in France (as *Neoplagiaulax* Lem.) bears date Nov., 1882, although its discovery was announced in 1880.

[3] Proceeds. Philadelphia Academy, Dec., 1876. Described by Gervais as *Simædosaurus*, Journal de Zoölogie, Feb., 1877.

[4] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[5] Bull. Soc. Min. de France, T. VI, p. 40.

axis, and occur in narrow prisms, either as radiated aggregates or as fibrous masses, filling cavities in damourite or pyrophyllite. The crystals are ordinarily so disseminated and so small that they are perceived with difficulty. They frequently occur in fibrous masses like cyanite. In fact, they were at first thought to be cyanite.

With cobalt solution a fine, blue color is obtained after heating. The mineral is insoluble in acid, except so far as a yellow discoloration of the liquid is produced by the contained iron. Heated in the matrass, water is given off without decrepitation. The mineral turns slightly yellow on exposure to the air. It has a fibrous appearance under the microscope. In its infusibility, its hardness, its cleavage, and, as Bertrand has shown, in its angles, the mineral is similar to cyanite.

Its composition, however, shows it to be a distinct species. The following is a mean of two analyses, after subtracting 16 per cent. of gangue:

SiO_2	Al_2O_3	MgO,CaO,FeO	H_2O	
50.5	31.9	3.4	14.2	= 100

giving the formula Al_2O_3, 2 SiO_2 + 3 H_2O.

Empholite appears to be a more hydrous variety of the new mineral davreuxite.

THE CORNWALL TIN ORES.—Mr. J. H. Collins contributes to the *Mineralogical Magazine*[1] his third paper on the tin ores of Cornwall, England. The associated minerals are much the same as in the other tin-producing districts of the world. Tourmaline is a very common associate of cassiterite, and appears to be of contemporaneous origin. So also are quartz, mica, feldspar, and sometimes apatite, topaz, garnet, hornblende, &c. Of more recent origin, being deposited on top of the cassiterite, are the sulphides of iron, copper, lead, and zinc, the oxides of iron, the carbonates of lime, copper, etc., and many other species.

The mineral known as Gilbertite, a greenish-yellow hydrated mica, almost invariably occurs with the Cornwall cassiterite. It is generally regarded as a variety of margarodite, but Mr. Collins thinks that it is a distinct species. It occurs massive, and also in spherical masses with radiated concentric structure, or in stellate groups, and sometimes in six-sided tables. Hardness, 1–2.5; specific gravity, 2.6–2.82. It has a greasy feel, like talc. At a high temperature water is given off. The analyses given closely correspond to the composition of margarodite.

As to the origin of the tin ores, the conclusion is reached that they have all been deposited in their present positions from stanniferous solutions, all being of aqueous origin. The presence of fluorine probably helped to keep the tin in solution. The tin was

[1] Vol. v, p. 121.

probably originally derived from the surrounding rock, and afterwards deposited by thermal waters in fissures.

In this connection a valuable paper in the *American Journal of Science* on the Genesis of Metalliferous Veins, by Professor Joseph LeConte, is of much interest in confirming this theory of vein formation. Metalliferous deposits are now being formed in California and Nevada, at Sulphur Bank and Steamboat Springs, through the action of up coming solfataric waters. Even cinnabar, generally supposed to have been formed by sublimation, is thus deposited from aqueous solution. The metals are deposited from solution in hot waters holding alkaline carbonates and sulphides, probably by reason of cooling and relief of pressure aided by chemical action as the waters approach the surface.

Professor LeConte holds that gold has in like manner been deposited from an alkaline sulphide solution, and there are strong reasons for believing that this is the true explanation of our metalliferous vein deposits.

THE MINERALS OF SKYE.—Professor M. F. Heddle[1] has described a new mineral locality in the island of Skye Quite a number of different zeolites occur in the igneous rocks, among them being thomsonite, farœlite, mesolite, stilbite, analcite, laumonite, chabazite, gyrolite, and apophyllite. Saponite of a pale red color, rarely oil-green, occurs in minute botryoidal groupings, and in thin, vein-like processes. Plinthite, a variety of bole, falling to pieces in water, occurs in various forms. It either occurs in beds of varying thickness among the strata, or in the form of clusters of spheres of the size of peas, or as a thin layer among the zeolites. Massive varieties of mesolite and of thomsonite, the latter sometimes called "rock soap," are also described, and several analyses are given.

MINERALOGICAL NOTES.—Mr. J. J. Dobbie directs attention, in the *Mineralogical Magazine*, to a variety of saponite from near Glasgow, which has some peculiar physical properties. The saponite has probably resulted from the alteration of a trap rock, and has a deep chocolate-brown color, a conchoidal fracture and the soapy feel so characteristic of most hydrated silicates of magnesia. It is dull, but may be highly polished by rubbing with the hand. When placed in water it splits into sharp angled fragments, ultimately crumbling. It has the chemical composition of saponite. ——Hausmannite has been produced artificially by A. Gorgen, and rhodonite by L. Bourgeois. Artificial hausmannite was made by heating chloride of manganese in an atmosphere charged with oxygen and steam, and rhodonite was produced by the fusion of equal parts of silica and binoxide of manganese.——Professor Des Cloiseaux has begun the publication of an extended article, in the June number of the Bulletin de la Soc. Min. de France, on the optical

[1] *Min. Mag.*, April, 1883, p. 115.

characters of some feldspars. More than 400 determinations of the optical constants of feldspars from numerous localities were made, including sixty-four varieties of oligoclase and andesite and thirty-seven varieties of albite. Only mineralogists who have been engaged in this kind of work can appreciate the labor involved. The results will be of importance in showing how far feldspars can vary from the type form while preserving their identity, and in distinguishing between such variations and the mixture or alternation of different species. Among the specimens examined is the moonstone from Mineral Hill, Penna., which is determined to be a *peristerite*, containing probably certain admixtures of oligoclase.——Some very beautiful transparent groups of apatite crystals have been found in the Untersulzbachthal, in Salzburg. They have a white color with a delicate tint of mauve. The largest of the specimens, so far found, has been deposited in the South Kensington Museum. They are beautifully terminated by a number of planes, and have an unusual luster.——The Oregon nickel ore is found in two varieties, which analysis has shown to be almost identical with the ores from New Caledonia—garnierite and noumeite. They also occur under precisely the same geological conditions. Garnierite has a pale apple-green color, adheres to the tongue, is not unctuous and falls to pieces in water. Noumeite is darker, does not adhere to the tongue, is unctuous, and does not fall to pieces in water. Noumeite contains more water than garnierite.

BOTANY.[1]

Ellis' North American Fungi.—In April the tenth and eleventh centuries of this important distribution were received, and a few days later Mr. W. C. Stevenson's Alphabetical Index to Centuries 1 to X. By means of the latter we are able to make a hasty analysis of the first thousand specimens. Running it hurriedly we note about half a dozen Myxomycetes and the same number of Mucorini. The Peronosporeæ are represented by three species of Cystopus and twelve of Peronospora. In the order Perisporiaceæ there are twelve species of Microsphæria, three of Erysiphe, and six of Uncinula. Tuberaceæ are represented by but a single species. Under Helvellaceæ the genus Peziza is represented by sixty-eight species, while of Pyrenomycetes there are of the principal genera as follows: Diatrype 14 species, Dothidea 13, Hypoxylon 13, Hysterium 11, Nectria 16, Sphæria 68, Valsa, 39. In the Uredineæ, Æcidium has 14 species, Phragmidium 4, Puccinia 19, Uromyces 15, and in Ustilagineæ of Urocystis 2, and Ustilago 5. Half a dozen or so species represent the Gasteromycetes, while of Hymenomycetes there are of Agaricus 10 species, Corticium 23, Hydnum 14, Irpex 5, Marasmius 9, Stereum 14. The order Saprolegniaceæ

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

is the only one of the ordinary Fungi which is not represented by specimens. It will be seen by the above that this distribution is one of great value to the student of any department of fungology, as the specimens are not confined to any restricted group of orders. The excellent index makes it an easy matter to find any species, and possessors of the work will thank Mr. Stevenson for compiling it.

Century XI is of unusual interest, as it is a special one devoted to the Uredineæ and Ustilagineæ. In it there are thirty-five species of Puccinia, which added to those in the previous centuries (all in Cent. III) make fifty-four species. Nine specimens of Ustilago and two of Sorosporium represent the Ustilagineæ. In this century a note informs us that the species "have mostly been determined by Dr. W. G. Farlow."

Since writing the foregoing, we have received a second valuable index also by Mr. Stevenson, and entitled "An Index to Habitats," giving in alphabetical order the habitats of the first thousand species. While not of as great value as the specific index, this will also prove to be useful.

NECTAR IN SPERMOGONIA.—Rathay has shown that insects are attracted to the spermogonia of Uredineæ by a sweet secretion. Many species of insects have been seen to visit the spermogonia, and without question the spermatia are carried away by them. One would scarcely have expected such a device in plants so far down the scale of vegetable life.

BOTANY AT THE MINNEAPOLIS MEETING OF THE A. A. A. S.—Botanists will find much to interest them in and about Minneapolis in August at the meeting of the American Association for the Advancement of Science. The collector will be able to add not a few strange Western plants to his portfolio without the trouble of making long trips. Upon or near the university campus he may get *Lygodesmia juncea*, *Artemisia frigida*, *Iva xanthiifolia*, *Petalostemon villosus*, *Pentstemon grandiflorus*, and many others of equal interest. The cliffs of the great gorge of the Mississippi river, just under the university, will entice many venturesome collectors, while others will find the less dangerous marshy land and the sand hills to the eastward not less interesting and profitable. The whole country westward and south-westward of the city is filled with ponds and lakes which teem with an unusual number of aquatic plants, especially of the lower orders. Desmids and Diatoms of rare beauty occur in great numbers, and ought to engage the attention of the microscopists. Charæ of several species abound, and will be in full fruiting stage at the time of the meeting. The larger fungi are likewise represented by an unusual number of species, while the rusts, smuts, mildews, etc., etc., sometimes denominated the micro-fungi, may be picked up almost everywhere. Surely the association has not for many

years met in a more naturally botanical place than Minneapolis will prove to be, and there should be as a consequence an unusually large attendance of botanists and plant collectors.

EQUISETUM ARVENSE L., VAR. SEROTINUM MEYER.—This "accidental state," as Gray calls it, has been found in considerable numbers this spring in Central Iowa. The specimens grew intermingled with the ordinary form, and there was nothing, so far as could be observed, in the conditions surrounding them which could account for their abnormal development. An attempt will be made to germinate the spores, should they prove to be perfect.—*C. E. Bessey.*

NEW PLANTS FROM CALIFORNIA AND NEVADA, ETC. I.—*Thelypodium neglectum*, n. sp.: Annual, 2°–5° high, glabrous throughout; stems stout, erect, striate, branching at the top; leaves oblanceolate, three inches long, all petioled; root leaves irregularly dentate; stem leaves long petioled, usually truncate at base, none but the uppermost entire; dense racemes panicled; pedicels ascending 1″–2″ long, sepals whitish, 2″ long; petals white, oblanceolate, 4″ long; stamens at length surpassing the petals; filaments glabrous; siliques flattened, slightly torulose, 3′ long, ⅓″ wide, style obsolete.

Vicinity of Santa Cruz and San Francisco, Cal., June, 1881.

Sisymbrium acuticarpum, n. sp.: Annual, 1°–2° high, stem simple or branched above, pubescent below, with scattered retrorse hairs; leaves all petioled; root leaves oblanceolate, obtuse, deeply crenate to almost lobed, 3′ long, petiole ½ the length of blade, which tapers gradually into it; upper leaves lanceolate irregularly dentate, petiole 1″–2″ long; inflorescence glabrous and often glaucous; flowers (usually not bracted) and pods sessile, strictly erect; sepals gibbous, yellowish and purplish, 1″–1½″ long, narrow; petals linear, light yellow, 2½″ long; stamens only equaling the sepals; pod terete, 1′ long, appressed, those near the root retrorsely pubescent, all bayonet-shaped, very acute; style 1″ long.

A plant with the habit of *S. reflexum*, and resembling it in the often elongated raceme and in the flowers, but differing in the pod and almost leathery leaves.

Near the head of the Valley of Palms, Mexico, and within a few miles of the California boundary, April 7, 1882.

Sidalcia calycosa, n. sp.: Annual, 2°–3° high, slender, erect, branching toward the top, pubescent, with scattered hairs; root leaves completely divided, long petioled, leaflets 6 or 7, oblanceolate, abruptly acute, tapering at base; stem leaves completely divided, petiole short, ¼′–1′ long, leaflets linear, 1′–1½′ long; lower stipules linear, acuminate, sparsely serrate; upper stipules broadly ovate, finely serrate, scarious; uppermost stipules nearly orbicular, subtending some of the peduncles,

while the leaf is often wholly absent; flowers rather long peduncled, clustered in heads or spikes; calyx large, loose, scarious or membranous, hirsute-ciliate with very long simple hairs, and also finely pubescent with stellate hairs, segments broadly ovate, abruptly acuminate with a slender point, very finely serrate, 3″ long; petals obovate, truncate, or retuse, erose, 6″–10″ long, light purple; carpels smooth, deeply striate on the back, reticulated on the sides, very strongly incurved.

A peculiar species, fruiting spikes resemble Lophanthus or *Orthocarpus lacerus.*

June 17, 1882, Duncan's Mill, Cal.—*Marcus E. Jones, Salt Lake City, Utah.*

Better Methods of Teaching Botany.—It is encouraging to notice from year to year a decided tendency in this country towards better methods of teaching botany in the schools and colleges. The idea is gaining ground that it is better to study the plant, independently of its classification, more, and the technical matters which have to do with classification, or *identification*, less. A year or two ago Professor Beal in a lecture before the Michigan State Teachers' Association presented very forcibly the objections and absurdities of the old methods, and sketched "The New Botany."[1] The favor with which this paper has been received indicates that the teachers of botany are striving to reach better things. They were ready to take up with the suggestion that pupils should study the plants themselves first; that they should find out by direct examination the structure of branches, buds, leaves, flowers, fruits, seeds, etc., etc. This method makes the fields and woods a great out-of-doors laboratory in which the real work of studying plants is done. Moreover, the object constantly kept before the student is to find out *all* about every plant, not just so much only as will enable him to find its scientific name. Often, in fact, many hours of interesting and profitable study are given to points in structure or physiology which are not made use of in the systematic manuals.

We have now before us a little book,[2] by Professor Macloskie of Princeton, the evident intention of which is to foster the mode of study commended above. A single sentence in the preface will suffice to show this. "It is better," says the author, "and more interesting to spend the leisure of a whole season on a single species than to hurry over a large number merely for the sake of discovering their names." This certainly is the right doctrine to inculcate, and while we should not take exactly Dr. Maclos-

[1] The New Botany: A lecture on the best method of teaching. By W. J. Beal, M.Sc., Ph.D. From the Trans. of the 29th meeting of the Mich. State Teachers' Association.

[2] Elementary Botany, with Students' Guide to the Examination and Description of Plants. By George Macloskie, D.Sc., LL.D., etc. New York, Henry Holt & Co., 1883.

kie's plan as outlined in his book, yet the book will probably do good in directing the attention of teachers and students into better lines of work.

Twenty-five pages at the beginning of the book are devoted to the examination of the morning glory, and it is not too much to say that any student who will carefully go through the work indicated here will have a better knowledge of the structure of a flowering plant than could be acquired by the "analysis and classification" of a dozen or more plants in the old way.

The last fifty pages constitute the guide to the examination and description of plants. Here again the student's attention is directed to finding out what the *structure* of the plant is, and little or nothing is said about the matter of determining the plant's place in any system of classification.

With the part of the book intended for the general reader we have strictly nothing to do in this article; however, it may not be out of place to say that the author has presented in plain and non-technical English the principal facts as to the structure of the flowering and flowerless plants. Some errors of statement mar the pages here and there, due, doubtless, to hasty writing. Thus "All dicotyledonous plants have *open* bundles" requires modification; so, too, the statement that the ducts in the rattan cane afford a "free passage-way for the sap;" and that the large intercellular spaces of aquatic plants are "for economizing material." —*C. E. Bessey.*

BOTANICAL NOTES.—A. P. Morgan continues in the Journal of the Cincinnati Society of Natural History his Mycologic flora of the Miami valley, giving descriptions of sixty-six more species of Agaricus belonging to the sections Hyporhodii, Dermini, Pratelli, and Coprinarii. This paper brings the number of species of Agaricus up to one hundred and forty-six.——J. C. Arthur's paper "Some Algæ of Minnesota supposed to be Poisonous," from the bulletin of the Minn. Acad. Nat. Sci., Vol. XI, possesses unusual interest. Certain Nostocaceous algæ appear from the evidence to have caused the death of many domestic animals which drank of the waters of the lake at Waterville. The particular species which seems to have proved fatal is the *Rivularia fluitans* of Cohn. It occurs as little gelatinous balls "of the size of a turnip seed," studded with innumerable little points, giving them a bur-like appearance. They were afterwards found in small quantities in Lake Phalen, from which the water supply for the city of St. Paul is obtained. In the words of the author, "This discovery lends great additional interest to the real character of the Waterville plant."

ENTOMOLOGY.[1]

CAPRIFICATION.—We referred in the June number to interesting articles from Westwood and S. S. Saunders on the fig caprifi-

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., may be sent.

cators. The manner in which caprification or fertilization of the cultivated fig is effected through these insects has often been dwelt upon, and was discussed by the earliest writers. Three important works have recently been published on the subject, one by Solms-Laubach, one by Fritz Müller, and one by G. Arcangeli. Solms' work[1] is the most exhaustive, and to give some idea of the way in which the female flowers of the fig are fertilized by the male flowers of the caprifig, we quote the following from a notice of the work in *Nature:*

"With regard to caprification, it was known to the ancients that an insect inhabits the fruit of the caprifig, and they also discovered that the visits of this insect to the fruit of the fig exercised some beneficial influence, either in accelerating ripening or in hindering the fall of the fruit before it was ripe. Consequently branches of the caprifig were hung on the fig trees at a certain season to insure these visits, and effect what was termed caprification. The insect that operates in this manner is a small hymenopter (*Blastophaga grossorum* Grav. syn. *Cynips psenes* Linn.), the complete annual cycle of development of which takes place within the three crops of fruit of the caprifig, whilst only one generation visits the fig, and that, as will be seen, to no advantage to the insect itself. In order to render what follows easily understood, we will give the present Neapolitan names of the three crops of the caprifig. The fruits that hang through the winter and ripen in April are called *mamme* (*cratitires* of the ancients). These are followed by the *profichi* (*orni*), which ripen in June, and the *mammoni* (*fornites*), which ripen in August and September. If we closely examine the profichi when fully ripe in June, we see here and there a black-winged insect emerging from the orifice at the top, its hairy body dusted over with pollen grains that have adhered to it in its passage through the zone of male flowers. And if we cut open one of these fruits we find a considerable number of these insects, all striving to find the way out. These are females, and associated with them are some helpless, wingless males, and very often a slender ichneumon as well. The female of this generation visits not only the *mammoni*, but also the fruits of the fig, if there are any at hand, in order to deposit her eggs. Now, the remarkable fact in connection with this is that she is able to do so effectually in the *mammoni*, but not in the edible fig, though she succeeds in penetrating the fruit far enough to convey pollen to the female flowers, perishing in the act. Furthermore, the insect that develops in the *mammoni* deposits eggs in the *mamme*, and the generation proceeding therefrom finds an asylum for its progeny in the profichi. Respecting the reproduction of the Blastophaga, Graf Solms claims to have made the important discovery that the eggs must be deposited within the in-

[1] Die Herkunft, Domestication und Verbreitung des Gewöhnlicher Feigenbaums (*Ficus carica L.*) Von Grafen zu Solms-Laubach. Göttingen, 1882.

teguments of the ovule itself; otherwise they do not develop. The fertility of the insect is astonishing, a very few of them being able to pierce the numerous female flowers of a fruit of the caprifig. For this purpose the ovipositor is thrust between the branches of the stigma, down the pollen channel of the style into the ovary, and into the solitary ovule itself. This act causes a gall formation, whilst it does not prevent the development of the ovule into an imperfect seed, which shelters and nourishes the larva that escapes from the egg."

MIGRATIONS OF GALL-MAKING PLANT-LICE.—G. V. Horvath (*Revue d'Entomologie*, T. II, 1883, pp. 64–7) has observed that *Pemphigus zeæ-maidis* Duf., which inhabits the roots of maize, flies in autumn to adjoining elm trees, and in time produces the winter egg, from which the following spring some gall-making form hatches. Lichtenstein concludes that this must be *Pemphigus pallidus* Hallid., which F. Low has shown to be synonymous with *Tetraneura alba* Ratzb. The connection of the two insects yet lacks proof, and seems improbable.

SAMIA CYNTHIA FEEDING ON THE SASSAFRAS AND TULIP TREE.[1] —Until 1882 the larvæ of *Samia cynthia* have, so far as I know, never been found feeding on any plant or tree but the ailanthus tree. Professor C. V. Riley, in one of his entomological reports, mentions feeding them on plum; but these larvæ were probably placed on plum, and had no choice of food.

Towards the end of the summer of 1882 I found eggs of *Samia cynthia* on three sassafras trees in the suburbs of Washington. They had been laid on the sassafras in preference to ailanthus trees, several of which are growing about 150 yards off. The larvæ from these eggs grew rapidly on the sassafras leaves, and attained their full growth and spun cocoons before most of those which fed on ailanthus. Up to this time all appeared to have gone well with them; but when, in December, the cocoons were collected, I found, on cutting them open, that not one contained a live chrysalis, and that the majority of the larvæ had died before turning to the pupa state. There were about 150 cocoons cut open with the above result.

I found also that seventeen Cynthia cocoons, which I collected from tulip trees, were in the same condition. No sign of insect enemies appeared. The larvæ seemed to have shriveled up.—*H. H. Birney.*

LICHTENSTEIN'S NOMENCLATURE OF THE VARIOUS PHASES PRESENTED IN THE LIFE-HISTORY OF THE APHIDIDÆ.—While the *Entomologists' Monthly Magazine* (March, 1882, p. 224) thinks proper to publish a translation of my introduction to Adler's "Cynipidæ," the AMERICAN NATURALIST considers my attempt to explain the

[1] Abstract of a paper read before the Biological Society of Washington, April 27.

biology of the Cynipidæ as a very amusing illustration of the insufficient and misleading nature of my theory regarding the evolution of the Aphididæ. Really, as the French poet says,

* * * Je n'avais mérité
ni cet espèce d'honneur, ni cette indignité, * * *

and as I consider the judgment of the entomologists of the new world of great value, I trust friend Riley will allow me a few words of explanation.

First of all, as I was already called in the French Academy at Paris "*Le Romancier du Phylloxera*," because I had described the curious migrations of *Phylloxera quercus* from one kind of oak to another, I do not take the word "amusing" in its bad sense; on the contrary, for the first quality in a novel writer is to amuse his readers, and the second to be exact and truthful in his observations.

Now, if I like to call winged females (?) (curious females laying eggs or young ones without males) *larvæ* and the eggs giving birth to perfect imagos *pupæ*, whom do I harm? In the first lines of my work, explaining my theory, I take care to say that I call *larvæ* all stages of an insect preceding the imago, and *pupa* the last envelope out of which issues the sexual imago.

With this understanding I have described the evolution of many plant-lice, and established a theory which, of course, meets with exceptions; but exceptions prove the rule, and one of the best observers of plant-lice, Dr. Kessler, of Cassel, concludes his interesting studies on the elm gall-louse with the words: "Es wird der Bestätigung der Lichtensteinschen Theorie über die Entwickelung der Aphiden immer näher getreten."

So let us lay aside the discussion of mere words and not lose time in deciding whether I would have done better to have called, as Riley does, all winged forms *females* instead of *Pseudogynæ*, and all eggs *eggs* instead of *gemmations* and *pupæ*, reserving the word *egg* for the product of the true sexual female. *Larva*, which means *a mask* in Greek, is a word applicable to all forms occulting an imago, and even good authors in America in their lectures (see Riley in No. 5 of the Saturday lectures of the Biological and Philosophical Societies of Washington, April, 1882) speak of very curious higher animals (Axolotl and Amblystoma) reproducing in larval form, which is precisely the phenomenon on which I insist in my theory of the evolution of plant-lice and Cynipidæ.

I endeavor to explain by common illustrations my conception of the biological evolution of the Aphididæ in the same way as Baron von Gleicher, De Geer, and Götze, viz: that the easiest way to understand the wonderful metamorphoses of plant-lice is to compare them to plants.

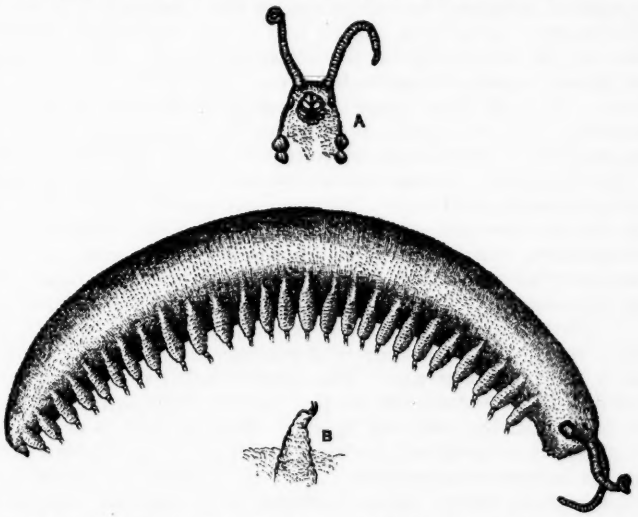
"Es ist also hier nicht anders zu schliessen als dass die Fortpflanzung dieser Insekten bloss durch ein pflanzenmässige Aus-

prossen in ihrem Leibe, und gleichsam durch Ableger geschehen muss" (von Gleichen 1770).—*F. Lichtenstein, Montpellier, France.*

[We gladly make room for this communication from our esteemed friend without further argument at present. The letter has been in hand for some time, and its publication delayed by an oversight.]

ZOÖLOGY.

NOTE ON A PERIPATUS FROM THE ISTHMUS OF PANAMA.—The only specimen of this interesting genus which, so far as we are aware, has ever been found in North America, was discovered by Mr. John McNiel, who collected one specimen at a station on the Panama railroad. This specimen is in the museum of the Peabody Academy of Sciences, Salem, Mass. I noticed very briefly the occurrence of this species in the annual report of the Peabody Academy published in April, 1869, and referred it,



though with hesitation, to *Peripatus edwardsii* Blanchard. Grube's specimens came from Venezuela. The late Professor James Orton collected a single specimen from the banks of the River Napo, which I also referred in the above-mentioned note to *P. edwardsii.* Afterwards in our "Zoölogy" we referred to this specimen as follows: "Either *P. edwardsii* Blanchard, or an undescribed species about four centimeters in length (with twenty-seven pairs of legs), inhabits the Isthmus of Panama." Where the Orton specimen now is I do not know.

The accompanying drawing represents the Panama specimen; it was made by Mr. Emerton, and well represents the alcoholic

specimen, the attitude not however being a natural one. Its color was black-brown. The figure represents the specimen magnified about three times. It had twenty-six pairs of feet. It may prove to be distinct from the South American *edwardsii* or the West Indian *juliformis.—A. S. Packard, Jr.*

THE STRUCTURE AND EMBRYOLOGY OF PERIPATUS.—This link between the worms and tracheate Arthropods has received much attention of late, owing to the recent elaborate account of it by Moseley, who brought from the Cape of Good Hope an abundance of alcoholic specimens. The late Professor Balfour was engaged just before his death in investigating the structure and embryology of *Peripatus capensis*, with the view of publishing a complete monograph of the genus. His drawings and notes have been edited by Messrs. Moseley and Sedgwick, who publish them, with an account of the external characters, generative organs and development, prepared by themselves, in the *Quarterly Journal of Microscopical Science* for April; it is a most important contribution to our knowledge of this interesting form. The drawings are upon a large scale and materially assist in making the subject clear. We will glean some extracts of more general interest from the paper, as bearing both upon the generalized nature of the anatomy, as well as early development of this transitional form.

The pharynx is unlike that of any true Arthropod in forming a highly muscular thick-walled tube, and presents "a very close and obvious resemblance to that of many of the Chætopoda, a resemblance which is greatly increased by the characteristic course of the sympathetic nerves. The form of the lumen, as already pointed out by Grube, resembles that of the Nematoda."

The buccal cavity is described in the paper before the pharynx, there being "no sharp line of demarcation between the buccal cavity and the pharynx." The editors describe a tongue-like mass[1] with chitinous teeth on the median ridge, while the jaws are fully described and well figured. They are said to be "a pair of appendages, modified in the characteristic arthropodan manner, to subserve mastication. * * * They are essentially short papillæ, moved by an elaborate and powerful system of muscles, which are armed at their free extremities by a pair of cutting blades or claws. The latter structures are, in all essential points, similar to the claws borne by the feet, and like them, are formed as thickenings of the cuticle. They have therefore essentially the characters of the claws and jaws of the Arthropoda, and are wholly dissimilar to the setæ of Chætopoda." Neither the figures nor descriptions of the present paper would entirely satisfy

[1] Although this mass is called a tongue, it would appear to us, judging solely by Figs. 5 and 7, to correspond rather to the membranous upper lip of insects and Limulus and Phyllopod Crustacea; the tongue in insects rests upon the floor of the buccal cavity, while this is represented as situated in advance of and rather above the jaws. Compare also Balfour's Embryology, p. 317.—*A. S. P.*

us as to the arthropodan nature of their teeth, but Professor Moseley's earlier memoir on the development of Peripatus, appears to us to indicate that they are the branch-homologues of the mandibles of Arthropoda, the mouth-region of the adult Peripatus being somewhat degenerated as compared with the embryonic structure.

We have here also interesting descriptions of the histology of the (for an Arthropod) strangely arranged nervous system, with its two widely separated nervous cords. The account of the tracheæ corroborates, in the main, Professor Moseley's earlier account. Says Balfour: "The apertures of the tracheal system are placed in the depressions between the papillæ or ridges of the skin. Each of them leads into a tube, which I shall call the tracheal pit (Fig. 30), the walls of which are formed of epithelial cells bounded towards the lumen of the pit by a very delicate cuticular membrane continuous with the cuticle covering the surface of the body. * * * Further investigation proved that the tracheæ actually started from the slightly swollen inner extremity of the narrow part of the pit, the expanded walls of the pit forming an umbrella-like covering for the diverging bundles of tracheæ. * * * The tracheæ themselves are extremely minute, unbranched (so far as I could follow them) tubes. Each opening by a separate aperture into the base of the tracheal pit, and measuring about 0.002^{mm} in diameter. They exhibit a faint transverse striation which I take to be the indication of a spiral fiber. * * * Moseley states that the tracheæ arise from the skin all over the surface of the body, but are especially developed in certain regions. He finds a 'row of minute oval openings on the ventral surface of the body,' the openings being 'situate with tolerable regularity in the centers of the interspaces between the pairs of members, but additional ones occurring at irregular intervals. Other similar openings occur in depressions on the inner side of the conical foot protuberance.' * * * There is a double row of apertures on each side of the median dorsal line, forming two sub-dorsal rows of apertures. The apertures are considerably more numerous than the legs. There is also a double row of openings, again more numerous than the legs on each side of the median ventral line between the insertions of the legs. Moseley speaks of a median row in this position. I think this must be a mistake. * * * Both the dorsal and ventral rows are very irregular." A considerable number of openings were found around the base of the feet, and the dorsal rows of tracheal apertures are continued into the head and give rise to enormous bundles of tracheæ.

The body-cavity is formed of three compartments—one central and two lateral, the latter containing the "segmental organs," which are regarded as probably of an excretory nature and homologous with the nephridia or segmental organs of the Chætopod worms.

Concerning the earliest phases of development of Peripatus, which had not been treated of by Moseley, Balfour left some drawings and sections, which, with other sections made from material which he left, are worked out by Moseley and Sedgwick. In a letter to Professor Kleinenberg he described the blastopore as an elongated slit-like structure extending along nearly the whole ventral surface; and further states, as the result of his examination of the few and ill-preserved embryos in his possession, that the mesoblast appears to originate as paired outgrowths from the lips of the blastopore.

The editors thus briefly summarize the more important facts of the early development of Peripatus:

1. The greater part of the mesoblast is developed from the walls of the archenteron.

2. The embryonic mouth and anus are derived from the respective ends of the original blastopore, the middle part of the blastopore closing up.

3. The embryonic mouth almost certainly becomes the adult mouth, *i. e.*, the aperture leading from the buccal cavity into the pharynx, the two being in the same position. The embryonic anus is in front of the position of the adult anus, but in all probability shifts back, and persists as in the adult anus.

4. The anterior pair of mesoblastic somites gives rise to the swellings of the preoral lobes and to the mesoblast of the head.

Peripatus is indeed a remarkable type. Agreeing with the lower worms in its pharynx, and especially its widely separated nerve cords, and with the annelids in its segmental organs; in its tracheæ and the mode of its early embryonic development it is without doubt an Arthropod. As Balfour has stated, no worm embryo has procephalic lobes, and a glance at Moseley's Fig. 2 (Balfour's Comparative Embryology, Fig. 169) shows conclusively that the animal is an Arthropod, rather than a worm. It is truly a connecting link between the Arthropods and worms, though dwelling just within the confines of the former sub-kingdom. With no real affinities to the Myriopods, it may be regarded as forming a sub-class next below them. Haeckel's term Protracheate, well defines, so far as a single word can do so, its ancestral nature.—*A. S. P.*

The Development of Renilla.—An abstract of Mr. E. B. Wilson's researches on the development of Renilla, a highly specialized halcyonoid polyp, appears in the Proceedings of the Royal Society of London. After describing the embryology and studying the mode of origin of the buds, he shows how the zoöids develop. It appears that the chief or zoöid head ("hauptzoöid") is formed at an early stage as a median bud upon the axial polyp, its function being to discharge water from the colony. "The other zoöids draw in water from the exterior by the action of the cilia which line their cavities. This is true also of the sex-

ual polyps in their early stages (though this function is entirely lost as they become older). Hence the zoöids are physiologically as well as anatomically identical with the young polyps; they are, in other words, polyps in a state of arrested development. The taking in of water is of vital importance to the organism, since the movements of the peduncle, by which the creature creeps, are effected by forcing the water to and fro. In this fact we find, probably, the explanation of the very early appearance of buds upon the axial polyp."

The facts, of development, as far as they go, indicate the derivation of Renilla from a form related to the Bathyptileæ, which probably possessed a horny axis. Bilateral symmetry is strongly exhibited both in the individual polyps and in the entire colony. The author concludes that the bilateral environment determines the bilateral structure.

Finally discussing the polymorphism of Renilla, the author attempts to show that the zoöids are probably not degenerated polyps, but buds in a state of arrested development, whose direct ancestors never possessed a more highly organized structure than at present.

A NEW PARASITIC COPEPOD CRUSTACEAN.—During the summer of 1880 and 1881 I received alcoholic specimens of a Caligus or fish-louse, gathered from the skin of the "salmon"[1] inhabiting Puget sound, Washington Territory.

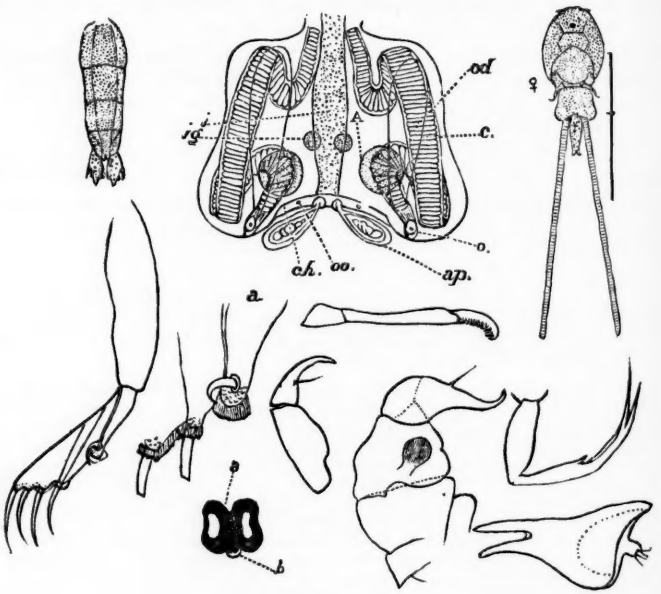
The female.—The form is convex, ovoid, color on dorsal surface dark rufous, on ventral somewhat lighter. The first abdominal segment has the form of that of *Caligus americanus* Dana and Pickering,[2] numerous specimens of which I have had lately occasion to examine. This segment measures $2\frac{1}{2}^{mm}$ in width by $2\frac{2}{5}^{mm}$ in length. The second abdominal segment measures 2^{mm} in length exclusive of the appendages, and three-fifths of a millimeter at its widest diameter. After treating it with acetic acid it is seen to consist of four distinct segments. This segment is cylindrical in form, slightly tapering toward its tip. The mandibles of the buccal mass appear to be two-jointed, the basal joint probably movable, the second joint connate. The first maxilliped is provided with a knob-like lateral process on the penultimate joint. This process is transversely ruled with parallel rugose lines, rendering it fit for trituration. The large hooked spine, the outer branch of the first maxilliped, is present and is of the same form as in *Caligus americanus*. The second rudimentary maxilliped, which has the shape of a short, thick, hexapodous mandible, is deeply cleft at its middle. The first pair of maxillipeds is two-jointed; instead of an ensiform extension it is furnished with a sharp tooth at the inner side near the middle of the second joint. This second joint terminates with a longer and a shorter blade-like flat bristle edged with a delicate pectinate membrane. The fourth pair of maxillipeds has a very stout terminal claw beset with one or two bristles at its middle. The inner side is notched near the base of the first joint, apparently for the insertion of the terminal joint, the claw. The second pair of natatory legs has its second joint continuous with the superior or outer branch. The interior or inner branch is not connate with the second, but with the first joint of the superior branch. The inferior branch has eight long pinnulæ, the superior branch has four long and three shorter pinnulæ and several larger spines. Not too much stress should be put on such inferior characters, as I have met with two female specimens of *C. americanus* having also eight pinnulæ on the inferior branch of the same leg.

[1] Probably the "blue-back salmon." See AMER. NATURALIST, 1881, p. 177, "Observations on the salmon of the Pacific," by D. S. Jordan and Ch. H. Gilbert.

[2] *Amer. Jour. Sci. and Arts*, 1838.

Length of female $9\frac{1}{2}^{mm}$, exclusive of the egg-tubes; width across the widest part of thorax about $4\frac{1}{2}^{mm}$. Length of the egg-tubes 15^{mm}, their diameter $\frac{2}{3}^{mm}$. Twenty-three female specimens.

Caligus pacificus, as we may call it, appears to be closely allied to *C. productus* Dana. No male specimens observed. The size of the specimens were remarkably uniform, only a trifling difference could be noticed. The shape of the foliaceous abdominal appendages as well as the arrangement of their setæ are better understood by an illustration than by a description. The visual



Caligus pacificus, female.

FIG. 1.—*Caligus pacificus*, dorsal view of female, twice enlarged. FIG. 2.—First abdominal segment, about thirteen times enlarged, ventral view; *i*. intestine; *od*, oviduct; *A*, large yellow (cement?) gland; *o*, orifice on a minute lappet, with which the external egg-tube connects, exit of oviduct; *ap*, spermatophores; *oo*, true female orifice (?); *ig*, gland; *c*, "false ovaries;" *ch*, chitinous bead. FIG. 3.—Second abdominal segment with appendages. FIG. 4.—Fifth leg of posterior thoracic segment; 4*a*, margin enlarged showing a hyaline fringe. FIG. 5.—Left mandible. FIG. 6.—Left first maxilliped. FIG. 7.—Right third maxilliped. FIG. 8.—Right second maxilliped, inner view. FIG. 9.—Fourth maxilliped. FIG. 10.—Eye; *a*, anterior; *b*, posterior side.

organ consists of two large lateral and two minute posterior masses of pigment. A semilunar larger refractive body encircles the posterior median mass of pigment. Two very small cylindrical vesicles are invariably seen juxtaposed on the ventral surface and in the median line of the posterior terminus of the first

abdominal segment. They are of a dark yellow color and are composed of two layers of coatings, an outer very thick and an inner very thin one. The outer is tough and elastic. The intima is a viscid glue-like mass. These organs, which I take for spermatophores, are fastened by their narrow tubular end to a chitinous transverse piece of integument. A little more laterally and on the same chitinous piece are two very minute circles, which may be the true sexual orifices. The oviduct and the so-called "false ovaries" do not differ from the description and illustration given by Dana and Pickering (*C. americanus*). A pair of smaller roundish "glands" occurs a little behind the middle of the intestinal tract. Another pair of larger roundish masses, of a yellow color, occurs more laterally and more posteriorly than the preceding. They may secrete the material for the egg-tubes.

ZOOLOGY AT THE NAPLES STATION.—The third volume of the briefer papers and memoirs emanating from the zoölogical station at Naples, dated 1882, form a thick octavo volume entitled Mittheilungen aus der Zoologischen Station zu Neapel. One of the more notable articles is that in continuance of Dr. Lang's researches on the comparative anatomy and histology of the nervous system of the flat-worms; also his paper on the structure of Gunda. To Cœlenterate literature belong A. Weissmann's paper on a peculiar organ of *Eudendrium racemosum;* Bedot's notice of the Siphonophores of the Gulf of Naples; Andres on a case of scissiparity in an Actinia; G. v. Koch's notice of the Neapolitan Gorgonians and the development of *Gorgonia verrucosa;* and his essay on the development of the coral-stock. A parasitic Eunice-like worm is described by J. W. Sprengel. The Crustacea have been treated by Kossmann in his paper on the Entomiscidæ, and his studies on the Notodelphyidæ. A contribution to ichthyology by C. Emery; and Dr. Dohrn's valuable studies on the primitive history of the vertebrate body are the more purely zoölogical contributions.

THE ELECTRIC ORGANS OF THE TORPEDO.—Professor Fritsch has, by his studies upon the development of the electric organs of the torpedo, proved that they are developed from the outer gill-muscles of the fifth gill-arch. These, which in rays and sharks form the extraordinarily powerful lower-jaw muscle, are absent in the torpedo, while the electric organs are developed in their place. In the first stage of its development the structure of the electric organ is similar to that of embryonic muscle, as distinct longitudinal striæ and traces of transverse striation are evident.

KING-BIRDS, TYRANNUS INTREPIDUS, FEEDING THEIR YOUNG UPON FRUIT.—In the summer of 1880 a pair of king-birds had their nest in the orchard, and during the season they became very familiar, and frequently alighted on the shrubbery around the

house. When the fruit of the bush honeysuckle, *Diervilla trifida*, began to ripen in June, the old birds visited the shrub often and ate very freely of the berries and carried a liberal supply to their young. During the last four days that the nestlings were confined at home, a large share of their food furnished by their parents consisted of this fruit, and as soon as the young were able to fly they were conducted by their parents to the bush and for several days honeysuckle fruit formed the greater part of their food.

So tame did these birds become that the whole family would occupy the bush for twenty minutes or half an hour at a time and eat fruit until I almost wondered where the little ones could store away so much, while the inmates of the house stood or sat in the doorway within four or five feet of them. We did not attempt to drive them away but much enjoyed their company, and this family of intrepid flycatchers continued to be frugivorous until the bush was gleaned, occasionally sandwiching the fruit with insects which attempted to pass.

I had observed the same act in previous years, and have since, but this was the most persistent fruit-eating of this kind that I have noticed.

I have repeatedly seen the young birds feed upon the wild soft fruits of the pasture before and after leaving the nest.—*Elisha Slade, Somerset, Mass.*

Characteristics of Women. — Some time since Professor Bischoff showed that the development of the labia majora in man constitutes a mark of distinction between man and the apes. In the orang only are they found in a rudimental condition. From an evolutionary standpoint their presence in man is doubtless due to the assumption of the erect position, which crowded the external genitalia into a narrower space and produced the additional fold in question.

Blanchard in the Bulletin of the Socété Zoölogique de France[1] describes the extraordinary development of the nymphæ in the bushwomen of South Africa, and gives chromolithographs of them copied from the drawings of Lesueur.

Bischoff has examined the characteristics of the Fuegian women who were recently exhibited in Germany and who died there. He finds nothing remarkable in their genitalia excepting the absence of hair. He says they did not menstruate while in Europe, and is inclined to think that this is their normal condition. He reminds us that the women of arctic regions do not menstruate during the colder half of the year, and that in the northern countries of Europe this function is often performed at intervals of two or three months.

He thinks the constant work which occupies the women of sav-

[1] 1883, p. 34.

age races and the poor of Europe, reduces the size of the fœtus and causes easy parturition.

Zoological Notes.—*Cœlenterates.*—Jickeli publishes an article on the histology and anatomy of hydroid polyps in Gegenbaur's Morphologisches Yahrbuch, while a number of important articles on medusæ, particularly on the development of the spermatozoa and of the nematophores, by Merejkowsky, appear in the last number of the Archives de Zoologie Experimentale et Generale.—— In a paper on the cyclical development and the relationships of the Siphonophora, in the Annals and Magazine of Natural History for March, C. Chun regards *Monophyes primordialis* as the stem-form of the siphonophores; how certain other genera have arisen from this form is indicated; the very thoughtful essay is not of a nature to be condensed.

Mollusks. — The Solenoconchs, though so feebly represented upon the coasts, are, according to Dr. Fischer, both abundant and varied in the depths of the seas. Their organization permits them to live among the sand and mud, and though deprived of eyes they capture Foraminifera around them by means of their tentacular filaments. During the *Travailleur's* three expeditions Dentalia were brought up at each haul of the dredge, at some spots in great quantity. *Dentalium agile* was found by hundreds, though it does not occur upon the coasts, and two very large species were discovered, one between Morocco and the Canaries, at 2000 meters; the other off the south of Spain, at 400 meters. The last is exactly like a Pliocene species that occurs in Italy. These and many other observations tend to show that a great number of Pliocene forms yet exist in the depths, and that the Pliocene, Quaternary and recent epochs are intimately related, and constitute a homogeneous period quite distinct from the Miocene.

Arthropods.—In his contributions to the history of the fresh-water Copepoda, Mr. F. W. Cragin describes with much detail and with good figures some of our American species of Cyclops observed at Cambridge, Mass. Several descriptions are from the Russian, but the object of introducing them into the present paper is not made plain, as it is not stated whether they inhabit North America or not; neither are the Russian localities given.——At a recent meeting of the Linnean Society Sir John Lubbock read a paper upon the "sense of color amongst some of the lower Animals." He said some years ago M. Paul Bert made a series of interesting experiments with the common Daphnia, or water-flea, and he thought himself justified in concluding that its limits of vision were the same as our own. In a previous communication, however, he had shown that at the violet end of the spectrum the eyes of the Daphnia are affected by light which we were unable to perceive. More recently he had made further experiments, from which he concluded that the Daphniæ are able to dis-

tinguish yellow and green light, and that they prefer either to white light. No such result was given with blue or red solutions. In such cases the Daphniæ always preferred the uncovered half of the trough in which the experiments were made. It was, of course, impossible absolutely to prove that these creatures perceived colors; but these experiments certainly showed that rays of various wave-lengths produced distinct impressions on their eyes; that they preferred rays of light of such wave-lengths as produce upon our eyes the impression of green and yellow. On the whole, he concluded that Daphnia can distinguish not only different degrees of brightness, but also differences of color.—— The paper of Csokor on the pig Demodex (*D. phylloides*) has been translated into the Proceedings of the Canadian Institute by Professor R. R. Wright. These mites cause the formation of subcutaneous abscesses frequently as large as a hazel nut. Its occurrence in Canada was announced by Wright in the NATURALIST for December last.

Vertebrata.—A number of ichthyological papers of a descriptive character appear in the Proceedings of the United States National Museum. Four new species of sharks from Mazatlan, Mexico, are described by Messrs. Jordan and Gilbert; one species of Carcharias is closely allied to the fresh-water shark of Lake Nicaragua. They also describe a new species of Carcharias from San Diego.——Dr. Bean notices the occurrence of a silver lamprey (*Ichthyomyzon castaneus* Girard) in Louisiana, which he refers, however, with *I. hirudo* and *I. argenteus* Kirkland to Petromyzon. Rosa Smith and Joseph Swain describe five new species, and notice at some length numerous other fishes from Johnston's island, located about seven hundred miles south-west of the Hawaiian islands.——A new species of Uranidea, from Lake Michigan, is also described by Gordon and Gilbert, who also notice at length certain fishes observed about Pensacola, Fla., and Galveston, Texas, and at Cape St. Lucas.——The pipe fish (Syngnathinæ) of the United States have been revised by J. Swain, his paper appearing in the Proceedings of the United States National Museum for 1882.——*Eurypharynx pelecanoides*, according to the illustrations copied from the *Magasin Pittoresque*, is certainly one of the most singular of earth's inhabitants. The head is short, occupying about an inch and a quarter out of the more than nineteen inches of the length of the fish, yet the mouth is capable of enormous dilatation from the structure of the jaws. The suspensorium is exceedingly long, and the mandible, of two pieces, measures about four inches. Thus the articular angle lies far back, along the side of the body. The upper jaw consists of a long and slender stylet, probably the intermaxillary.——Herr Krukenberg, of Heidelberg, has studied chemically and spectroscopically the different pigments that he has extracted from the feathers of birds. Most of these are red or yellow; green pigments are rare.

M. Meyer (S. B. Akad. Berlin, 1882, 547) has also taken up this subject, apropos of a Moluccan parakeet (*Eclectus polychlorus*) which, though certainly undomesticated, had certain citron-yellow plumes where the usual color is green, blue, or black—a peculiarity which can be produced artificially upon birds kept in captivity. Thus the Indians of South America pluck out the feathers of parrots, and treat the new roots with the milky secretion from the skin of a small batrachian, with the result that the new growth of feathers is yellow. The aborigines of Gilolo, by giving animal food to *Lorius garrulus*, transform its plumage into that of the *Lori rajah*. The natural color returns after an exclusively vegetable diet. The green color so common in birds is due to an admixture of a yellow pigment (*Psittacofulvine* Krukenberg) with a dark brown one; and Herr Krukenberg states that no blue, white, or green pigment can be found among the parrots. He believes that all the darker pigments are derived from one substance, probably identical with Coriosulphurine, which is thus the most widely spread pigment in birds' feathers. ——The spring birds of Nebraska are enumerated, with notes, by A. Hall in *Forest and Stream*.——Mr. H. F. Osborn gives in *Science*, for May 25, the results of an examination of the fœtal membranes taken from a female opossum which had been captured within a few days after impregnation. From this and other specimens and facts, Osborn concludes that the so-called false chorion of some of the lower placental mammals in the marsupials functions as a true chorion, *i. e.*, the functions of the allantois in the placental mammals are, in a rudimentary way, performed by the yelk-sac in the marsupials. "Finally, some genera of the marsupials probably show the attachment of the allantois to the subzonal membrane, which is the first step towards the establishment of an allantoic placenta."

PHYSIOLOGY.[1]

Locomotor System of Medusæ.—Mr. G. J. Romanes concludes his observations of the locomotor system of Medusæ—observations which throw a new light upon rhythmic action generally. He believes rhythmic action to be a primary endowment of contractile tissue, the excitability of which under the constant stimulation of the element it exists in is alternately exhausted and restored. The action of ganglia is superimposed on this, and is timed so as to coincide with the normal pulsatile action of the muscular tissue. Muscular tones he attributes to a higher irritability in the structure than is possessed by rhythmic tissues.

The Origin of Fat in the Body.—In Pflüger's Archiv, Bd. 31, P. II, Dr. Lebedeff tries to show that the common view that fat may arise in the body as a decomposition product of albuminous matter, is erroneous. Dead bodies, under certain condi-

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

tions, seemed to have their nitrogenous tissues replaced by a fatty substance, adipocere. In phosphorous poisoning the nitrogenous tissues, particularly the liver, undergo a fatty degeneration. It is usually taught that the fat arises in these cases from the decomposition of tissue proteid, but Lebedeff seeks to prove that the fat found in the "degenerated" organs has made its way to them from the surrounding connective tissue, out of which it has been dissolved, to be again laid down in a less soluble combination. The disappearance of the proteid matter is due to an independent disintegration. The fat of the milk is not made by the protoplasm of the mammary gland cells, but comes ready formed to them from the blood. The view of nutrition, according to which proteid food by its physiological decomposition gives rise to fat in the body, has little experimental support.

THE FORMATION OF MILK.— Schmidt-Mühlheim denies the truth of the view that the formation of part of the milk obtained from a cow begins only with the process of milking, and that the udder is too small to accommodate all the fluid which may be obtained at one milking. The secretion as it is produced in the gland cells of the udder is forced gradually into the milk receptacles, but leaves much of its fat clinging to the walls of the gland ducts whence it is gradually washed off during the process of milking, hence the milk which is last drawn is richest in fat; there is no evidence, however, that the chemical proportions of the fluid vary with different periods of secretion. Even after the most thorough milking, some fluid still remains in the milk ducts, whence it is driven into the milk reservoirs by the newly formed secretion pushing from behind, and may then be obtained after the lapse of an hour.

INTERACTION OF THE SPINAL NERVE ROOTS. — Mr. Kanellis lays bare the spinal cord of a frog and divides all the nerve roots upon one side except a single pair. He then lays the anterior or motor root of this pair upon electrodes, and finds the strength of the electrical current, which is just too feeble to excite a muscular contraction. He then cuts the sensory root of the reserved pair and finds that the induction current now causes strong contractions when applied to the anterior root. It seems from the result as if cutting the posterior root had increased the irritability of the motor branch.

CHEMICAL DIFFERENCE OF LIVING AND DEAD MATTER.—O. Loew concludes, as the result of a long series of experiments, that it is only the albumen of the living cells of tissues that is capable of reducing silver salts, and therefore that the albumen is chemically changed in the death of the protoplasm of which it forms a part.

NUTRITION OF THE FROG'S HEART.—* * * In the non-vascular frog heart two groups of muscular fibers with different

action must be distinguished. The one class of fibers surrounds the fissures of the heart-wall, which perform the function of the vessels and admit the nutritive liquid to the tissue (vessel muscles); the others, by their regular contractions and dilatations, act in the way of moving the blood (proper heart-muscles). The contraction of the first kind of muscles closes the fissures and produces paleness of the heart-wall, and their dilatation opens the fissures, lets the blood penetrate into the substance of the heart, and reddens the heart-wall; while the action of the second group of muscles produces systole and diastole of the heart. Now the actions of these two kinds of muscles—the heart-vessel muscles and the proper heart-muscles—are not simultaneous and similar under the influence of local stimuli, removal of the brain, section of the spinal cord in different places, and poisons; sometimes the heart-walls were observed to be pale in diastole and deep red in systoles, and there were various other local differences of behavior. This led the author to seek also an anatomical difference of the two groups of muscles, and he found one such on microscopical examination, for the proper heart-muscle fibers were cross-striped throughout and had long cell nuclei, whereas in the others the cross-striping did not comprise the whole width of the fibers, and the nuclei were oval. With this anatomical difference the different mode of reaction of the two kind of muscles and their different function is intelligible.—*Nature.*

Effect of prolonged Hunger upon the Blood Corpuscles. —In May, 1881, a Mr. John Griscom, of Chicago, commenced a fast of forty-five days. The author (Lester Curtis, of Chicago) was invited by the "managers" to make any investigations that he pleased, and after satisfying himself that the fast was to be conducted honestly, he chose the blood as a subject of study. The first examination made, at the commencement of the fast, shortly after the patient had eaten his last meal, showed the red corpuscles abundant, bright-colored, pure in appearance, regular and smooth in outline. Four days afterwards two kinds were noticed, one pale, almost colorless, large with a "sticky" aspect, the other deeper in color than the ordinary corpuscles, smaller and covered with nodules. By the fifth day the colorless corpuscles had disappeared, but they returned in a few days, and continued in greater or less amount to the end. The darker corpuscles assumed various shapes, and many very small ones appeared, apparently by subdivision of the larger. Their aspect was most abnormal on the thirty-ninth day of the fast, when Mr. Griscom was extremely exhausted; but on the fortieth, after he had been refreshed by a rather long excursion on the lake, the corpuscles returned to a normal condition, except as regards size. This improvement was not lost during the remainder of the fast, though the abnormal appearance to some extent returned.—*Nature.*

PSYCHOLOGY.

THE ENGLISH SPARROW IN CANADA.—My first observation of the English sparrow in Canada was in 1874. In June of that year a pair was observed about the out-houses, and in a few days they became quite familiar, having evidently made up their minds to stay with us. I made them welcome for old acquaintance sake, and thinking they would make good settlers was about to put up a house for them, but before my well-meant intentions were carried out it became apparent that they were providing for themselves in a manner quite characteristic.

On a peak of the stable was a box occupied by a pair of swallows who were at this time engaged in rearing their young, and of this box the sparrows seemed determined to get possession. The swallows resisted their attacks with great spirit, and, their outcries bringing a host of friends to their assistance, the intruders were for a time driven off, but it was only to return again with renewed energy and perseverance. The swallows were now sorely beset, as one had to remain on guard while the other went in search of supplies. Still they managed to hold the fort till the enemy, watching his opportunity, made a strategic movement from the rear and darted into the box, quicker than I can tell it. He emerged again with a callow swallow hanging by the nape of the neck in his bill, and dropped it on the ground below, and soon another followed, amid the distressing cries of the swallows who, seeing their hopes so completely blighted, sat mute and mournful on the ridge of the house for a short time, and then went away from the place, leaving the sparrows in undisputed possession of the box, and there they remained and raised some young ones during the summer.

In the spring of the following year the numbers had increased, and they began to roost under the veranda round the house, which brought frequent complaints from the sanitary department, and a protest was made against their being allowed to lodge there at all. Still, in view of the prospective riddance of insect pests from the garden, matters were arranged with the least possible disturbance to the birds, and we even stood by and saw them dislodge a pair of house wrens who had for years been in possession of a box fixed for them in an apple tree in the garden. So the second year wore on, no farther notice being taken of the sparrows except that they were getting more numerous.

I had missed the sprightly song and lively manners of the wrens, and in the spring when they came round again seeking admission to their old home, I killed the sparrows which were in possession in order to give the wrens a chance, and they at once took advantage of it and commenced to carry up sticks in their usual industrious manner. They had only enjoyed possession for two days, however, when they were again dislodged.

Again the intruders were killed off, and domestic felicity reigned for three days, when a third pair of sparrows came along, bent on the same object, and, if possible, more overbearing and determined than their predecessors. This time I thought of a different mode of accomplishing the object in view, and taking down the box at night, nailed a shingle over the end and worked it flush round the edges; with a centre bit a hole was then pierced just large enough to admit the wrens, but too small for the sparrows, and the box put back in its place. Early in the morning the assault was renewed, but the wrens found at once that they were masters of the situation, and never were two birds more delighted. From his perch aloft the male poured forth torrents of scorn and ridicule, while the female inside the box fairly danced with delight, and I almost fancied was making faces at their enemy as he struggled ineffectually to gain admission or sullenly, but fruitlessly, tried to widen the aperture.

Shortly after this dispute was settled I noticed ten or twelve sparrows quietly at work at the grave vine, and, feeling pleased at the havoc they were apparently making among the insects, passed on, speculating mentally on the probable increase of fruit I would have. In the afternoon they had moved to another trellis, and I thought, "Well, they are doing the work systematically and, no doubt, effectually." But shortly afterwards, while passing the trellis where they commenced, a slight *débris* of greenery was observed along under the vines. This led to an examination, which showed, to my intense mortification, that the heart had been eaten out of every fruit bud where the birds had been, and nothing left but the outside leaves. The report of firearms was heard several times in the garden that afternoon, many dead and wounded sparrows were left to the care of the cats, and every crevice where the birds were known to breed closed up at once.

Since then the wrens have kept possession of their box, and with a little attention I can keep the sparrows out of the garden, as they find plenty of provender round the stables; but they are still on the increase, and if this continues in the future as in the past, the time is not far distant when the streets and stable yards will not furnish food enough for the increased numbers, and there is no question but they will then betake themselves to the fields and gardens and take whatever suits them. This is the serious view of the subject which has called for legislation in other countries, and may do so here unless some unexpected check arises to prevent the necessity for it.

In the mean time it is well that all parties having opportunity should take notes of the movements and increase of the birds for future consideration.—*T. McIlwraith. Hamilton, C. W.*

Instinct or Reasoning Powers in the Horse.—Not long since a fine blooded mare was brought here from Kentucky and

placed in pasture, and the owner, not expecting her to foal, took no particular care of her.

A couple of days ago she foaled while in the pasture and surrounded by many other horses, which made so much over her difficulty that she, being frightened, ran, with her weakling following after as best she could, in hopes to shelter herself and offspring from the torments of the herd.

In her excitement she made for the Floyd, a stream running through the pasture, some thirty yards in width, which she plunged into and swam to the opposite shore; the colt following, but lacking strength, did not succeed in leaving the stream, but with great tenacity of life clambered into some willows which grew on shore, and there remained, apparently "hanging on for dear life."

The mother, having discovered her error in getting the colt into such a position, either by "instinct" or a conclusion of mind, at once started for help, by swimming across the stream, and at full speed ran to the barn-yard some distance away where some men were at labor, and with furious neighing and other actions, like mad, attracted the attention of the workmen who, when they noticed her particular desire that they should follow her—by her showing great joy when they did—went to the stream and rescued the colt.

The mare showed them great kindness until she had recovered her offspring, when she became instantly very vicious and would not allow one of the rescuers to approach her.—*D. H. Talbot.*

How Snakes approach and swallow their Prey.—Speaking of snakes and their elastic throat capacity, it occurs to me that sixty years as naturalist and half a century as taxidermist would most likely bring several points of interest under an eye not totally blind. By practice a man will sit or stand motionless longer than he can at first believe possible, and it is only when this art is acquired that animals are fully over-reached. They seem to recognize life in a great measure only by motion.

I have had a creature touch my coat with his nose and pass on only a little suspicious. I have had a humming bird hang suspended within a foot of my own nose for half a minute looking me squarely in the eye, and as I did not even wink, return to flowers within an arm's length, with the very proper conclusion, "You look like a man, but I believe you are only an old stump."

Snakes approach their victim like the hour hand of a clock. There is no perceptible movement. One little spot of the body moves, while all the rest is fixed. The head moves by an impetus from the tail perhaps, and when striking distance is reached the muscles are gathered for the final spring. This is made with no regard to what part of the object is reached. If a frog is caught, as is often the case, by a hind leg, that leg goes down first, while the body follows in a bunch. If a snake catches a

neighbor by the head, as the water snake lately referred to was caught, he goes down head first; if caught by the middle, as I once knew to be done, he is swallowed double, and in this case the swallower was but six inches longer than the swallowed. The seven red squirrels I took from the body of my black snake followed each other head first, a most positive evidence of fascination, since it is hardly possible that such unbroken succession could be the result of any other process. But the snake is not the only creature that swallows "big things." I once cut from the throat of a hawk the foot, leg, shoulders, and shoulder blade entire of a muskrat. I once took from the neck of a merganser a sucker thirteen inches long whose head girth was double that of the duck. I cut from the throat of a heron a chicken as large as a woodcock, and sat almost an hour as "crowner's quest" before it got through my thick skull what those soft yellow feet and bill belonged to. This capacity for extension is common among birds and reptiles, owing to the flexibility of the posterior connection of jaws or mandibles, they being held together by muscular contraction, and not by articular joints as in mammals; distention does not produce dislocation.—*B. Horsford in Forest and Stream.*

Battle of Ravens.—The *Frankfurt* (Germany) *Journal* writes: The gardener, Mr. Georgius, from Ginnheim, called at our office today with a chest full of dead ravens, victims of a battle which was fought high in the air among a flock of over four hundred of these birds near the above-mentioned village. The ravens formed together into three detachments, and as if at a given signal flew at each other, and with savage cries seemed as if they would tear each other's eyes out or their heads off with their beaks. The ground was soon covered with the bodies of over fifty birds, which were picked up by observers. Wounds on other parts of the body except the head could not be found. The blows on the head appeared on close observation to have been given with such force that one was sufficient to destroy life. The cause of the battle was doubtless the fact that the pairing season of the birds was near at hand. Not only the males but also the females participated in the fight, as bodies of the latter were found among the slain.

ANTHROPOLOGY.[1]

The Society of Americanists.—The Congrès International des Américanistes will be held in Copenhagen, 21–24 August, under the patronage of Christian IX. Letters should be addressed to M. W. A. Carstensen, general secretary. All persons interested in early American history, by paying twelve francs, may become members, and will receive the published volume. The sum should be remitted to M. Tietgen, directeur de la Banque privée

[1]Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

de Copenhague. The programme includes the following subjects:

HISTORY AND GEOLOGY.

The discovery of N. America by European navigators.
The colonization of Greenland by the Northmen.
Mexican Calpullis, their administration and communism
Central American nationalities previous to the Aztec invasion.
Military systems of Mexico and Peru before the conquest.
Critical examination of the Popol Vuh.
Comparison of the kingdoms of Cezco, Trujillo and Quito, as to their religion, legislation, language, architecture, manners, &c.
Catalogue of ancient Peruvian divinities.
Migrations of the Carib race and their limits in S. America.

ARCHÆOLOGY.

Kjokkenmoddings in Greenland and other parts of America.
Sacred symbols found in America.
Religious and emblematic value of different types of idols, &c., in Peru.
Classification of the monuments of Peru.

ANTHROPOLOGY AND ETHNOGRAPHY.

Nomenclature of the peoples of America before the conquest.
The kingdoms of Cibola, Quivira and Tegnayo.
The tribes of New Granada and the Isthmus of Panama.
The aborigines of N. America and of Western Asia compared.

LINGUISTICS AND PALÆOGRAPHY.

Eskimo language compared with Indian languages.
Mexican compared with languages outside that region.
Decipherment of Maya inscriptions.
Quippus in relation to ancient forms of writing.
Peruvian languages on the coast and in the mountains compared.

THE SOCIETE D'ETHNOGRAPHIE.—In the excitement of present prosperity we must not forget the pioneers of our science. The Société d'Ethnographie of Paris has just celebrated its twenty-fourth anniversary. Its history may be briefly indicated:

Société d'Ethnographie Américaine et Orientale, founded 14th March, 1859, incorporated 26th April.

Société d'Ethnographie, this title assumed and recognized by the government 28th September, 1864.

The society took part in the Exposition Universelle de Paris, 1867; Congrès international des sciences Ethnographiques, under the patronage of the government, 1878.

The society founded the Institution Ethnographique, 1879.

The society recognized as an institution of public utility, 1880. The general secretary is M. Leon de Rosny.

FOLK LORE.—The folk tales of a people are to sociology what myths are to religion and stone implements to the history of technology. Societies for the collection of these tales and rhymes exist in various places, but the most active among them is the Folk Lore Society of London. The publications are as follows:

1878. The Folk Lore Record, Vol. I. (For members only.)
1879. Notes on the Folk Lore of the northern counties of England and the borders.
The Folk Lore Record, Vol. II. (For members only.)

1880. Aubrey's Remains of Gentilisme and Judaisme, with the additions.
The Folk Lore Record, Vol. III, Pts. I and II.
1881. Notes on the Folk Lore of the northeast of Scotland.
The Folk Lore Record, Vol. IV.
1882. The Folk Lore Record, Vol. V.
Researches respecting the book of Sindibad.
Portuguese Folk Lore.
1883. Folk Medicine.
Folk Lore Journal. Issued Monthly. Vol. I, part V, issued in May. Price 18 pence per number.

Address G. Laurence Gomme, F.S.A, 2 Park Villas, Lonsdale road, Barnes, S. W. London, England.

ANTHROPOLOGICAL SOCIETY OF LYONS.—The Anthropological Society of Paris occupies such a prominent position among the students of humanity, that other brilliant workers in the republic are overlooked. All the world have heard of Chantre, Faure, Guimet, Julien, Lacassagne, Lortet and Secard, founders of the Société d'Anthropologie de Lyon, in 1881. The first volume of the Bulletin covers the years 1881 and 1882.

THE TRENTON GRAVELS.—Dr. C. C. Abbott has contributed to the Boston Society of Natural History the result of a new find in the Trenton gravels (XXII, Oct. 18, 1882). In consequence of the removal of many thousands of yards of the gravel by the P. R. R. Co., there has been an extensive exposure of this deposit, showing that there have been breaks in the process of accumulation, strata of sand alternating with accumulations of coarser material. One sand stratum, one foot deep and three hundred yards along the exposure, furnished five argillite implements. The author supposes them to have been left by the ancient man on this little sandy island and subsequently covered by a gravel-bearing flood to the depth of seven feet. In the following pages mention is made of further discoveries of flint implements; and also, most wonderful of all, of a human wisdom tooth taken from the undisturbed gravel nearly fourteen feet under the surface.

LECTURES ON ANTHROPOLOGY.—Dr. E. B. Tylor delivered two lectures on anthropology at Oxford, February 15th and 21st, the first of which is reported in *Nature* of May 3d. There is no European anthropologist more popular in our country than Dr. Tylor, and for this reason a few of his salient utterances are quoted without comment:

"The processes of development, or evolution, or transformism, were long ago recognized to no small extent by ethnologists. Prichard, the leader of the monogenist school forty years ago, brought forward evidence of the derivation of the races of mankind from one original ancestral pair, whom he considered to have been negroes, whose descendants, more or less varying by the operation of natural causes, became modified or transformed into the several races adapted for life in the various climates of the earth.

"The discovery that men were already making rude flint implements in the Quaternary period has made a new scientific departure, placing primeval man in the hands of the geologists." To cross the border into the animal kingdom, and to see how one species is transformed into another, we have only to look at Huxley's series of horses: "Zoölogists, thus enabled to reconstruct ideally the ancestry of the horse, are hopeful some day to discover likewise the fossil pedigree of the rider.

"Anthropologists do not feel, therefore, that their science has been plucked up by the roots and planted somewhere else; it is growing where it is only cultivated higher than in old times."

Dr. Tylor next discusses craniology, and shows what is its true place in anthropology. The vexed question of philology, and its credibility as a witness of blood relationship is very cautiously handled. Regarding the hair, Dr. Tylor says: "The cross section of a single hair examined microscopically by Pruner's method shows it circular, oval, or reniform; its follicle-curvature may be estimated by the average diameter of the curls as proposed by Moseley; its coloring matter may be estimated by Sorby's method. The wonder is that a single bodily character should form a basis for rationally mapping out the divisions of mankind. It is now well understood that the causes of race color are not so simple as Hippocrates thought when he described the nomad Scythians as burned tawny by cold." The effect of inheritable albinism, Addison's disease, town life and other social changes, acclimating, Draper's law, and other known forces in bringing about permanent change of type is well worked out by the lecturer.

The closing part of the discourse is devoted to the development of civilization, survivals, etc. On the latter point attempt was made to offer examples of a mental state yet surviving among savages and peasants, which may have its origin in the very childhood of mankind. The notion is also advanced that the origin of races is to be sought, like the origin of domestic plants, in those regions where they are wild. Thus the negro race originated not in Africa but in Andaman and New Guinea, where the people have no fire drill, but carry about brands from place to place, and kindle new fires from their volcanoes. In like manner the origin of the civilization of the Aryan through those represented by the Egyptian and the Chinese is traced.

MICROSCOPY.[1]

ROSE BENGALE IN COMBINATION WITH IODINE GREEN AND BLEU DE LYON.—Rose bengale, according to Griesbach,[2] is the bluest of the eosine dyes. An aqueous solution is very useful in staining chromic acid preparations of the spinal cord, as it colors the gray substance much more strongly than the white substance.

[1] Edited by Dr. C. O. WHITMAN, Newton Highlands, Mass.

[2] *Zool. Anzeiger*, VI, No. 135, p. 172.

Rose bengale may be used in combination with iodine green and bleu de lyon in the following manner:

A section of an alcoholic preparation is first placed in distilled water; then quickly drawn through a deep red solution of rose bengale, and again placed in aq. dest. It is next laid in iodine green for a few seconds, washed, and placed for five minutes in absolute alcohol to remove any excess of color. It may be transferred directly from the alcohol to a dilute alcoholic solution of bleu de lyon (two parts alcohol abs. and three parts aqua dest.) and left for a few seconds, then replaced in the absolute alcohol preparatory to mounting.

DOUBLE STAINING WITH ANILINE DYES.—Dr. Vincent Harris contributes to the last number of the *Quarterly Journal of Microscopical Science* (Vol. XXIII, No. 90, p. 292) a valuable article on the use of aniline dyes in double staining. His experiments were made with solutions of definite strength in regular sequence, and confined to blood-corpuscles. The method of experiment finally adopted was as follows: The blood was spread in thin layers upon cover-glasses and allowed to dry in direct sunlight. The dried blood was then wet with a few drops of some dye, and after five minutes washed with a slow stream of water from a wash-bottle; it was then dried in the flame of a spirit-lamp and allowed to cool. A second dye was then applied in the same way; and after washing the preparation was mounted in balsam, without having recourse to alcohol and clove oil.

The following combinations of dyes were found to give good results:

Roseine and iodine green.
Fuchsine and methylene blue.
Fuchsine and Bismarck brown.
Eosine and vesuvine.[1]
Iodine green and Bismarck brown.
Hoffman's violet aud Bismarck brown.
Methyl violet and methylene blue.

Roseine followed by iodine green stained the colored corpuscles a bright red, with bluish-green nuclei; and the colorless corpuscles were so stained that three varieties could be readily distinguished.

Fuchsine and methylene formed a very successful combination. The methylene blue was used as a saturated solution in absolute alcohol.

Bismarck brown was prepared as a two per cent solution in dilute alcohol. In the use of this dye, it was found best to immerse the preparation twenty to thirty hours, as the color then remains even when passed through alcohol and clove oil.

An aqueous solution of Hoffman's violet was used with a dilute spirit solution of Bismarck brown.

The green dyes are not permanent. The solutions should be quite fresh in order to secure successful results.

[1] Regarded as identical with Bismarck brown.

Classified List of the chief Aniline Dyes, with their Solubilities in Water and Spirit.

BROWN.	RED.	ORANGE.	YELLOW.	GREEN.	BLUE.	VIOLET.
Bismarck — partially sol. in water; sol. in dilute spirit.	*Eosine* — Pink; freely sol. in water.	*Aurine*—Insol. in water; partly sol. in strong spirit; more so in absolute alcohol.	*Fluorescine*—Greenish-yellow; insol. in water; sol. in spirit, the solution being beautifully fluorescent.	*Iodine Green* — Blue-green; freely sol. in water or spirit.	*Soluble Aniline Blue* — Freely sol. in water.	*Hoffman's Violet* —Freely sol. in water and in dilute spirit.
Vesuvine — Sol. in water.	*Aniline Scarlet*—Insol. in water; sol. in methylated spirit.	*Aniline Orange*—Ditto, ditto.	*Aniline Primrose*—Only partly sol. in meth. spirits.	*Malachite* — Green, a less blue-green; freely sol. in water and in spirit.	*Bleu de Lyon*—Insol. in water; freely sol. in strong spirit.	*Methyl Violet* — The red predominating; sol. in water partially; freely sol. in spirit.
Chrysoidine—Sol. in water.	*Flamingo*—Deep brownish-red; partly sol. in water; freely so in meth. spirit.	*Tropæoline* — In deep yellow glistening scales; partly sol. in water; more sol. in methyl. spirit.			*Methylene Blue*—A very deep blue; freely sol. in water and in spirit.	*Gentian Violet*—The blue predominating; freely sol. in water.
	Ponceau[1]— Deep red-crimson; partly sol. in water; freely so in dilute spirit.	*Phosphine* —Yellowish-orange; partly sol. in water; more so in spirit.			*China Blue* — Freely sol. in water.	*Tyrian Blue* — Near to violet; sol. in water.
	Rosaniline—Partly sol. in water; freely sol. in dilute spirit.	*Saffranine*—Sol. in water and in spirit.			*Serge Blue* — Ditto.	*Spiller's Purple* —Sol. in spirit.
	Fuchsine—Partly sol. in water; sol. in dilute spirit.				*Blue Black* — Freely sol. in water.	

[1] Ponceau is a mixture of rosaniline and phosphine.

THRELFALL'S METHOD OF FIXING SECTIONS.—Mr. Threlfall has discovered a method for fixing sections on the slide which will be found superior to that of Frenzel, described in the July number of this journal.

"A thin solution of caoutchouc in benzine or chloroform is prepared and poured over the slide so as to form a film in the same way that collodium is poured on a photographic plate. When the film is dry the sections are arranged on it, and the temperature of the slide raised to the melting point of paraffine; the sections then fall on to the India rubber film which has become sufficiently sticky to adhere to them perfectly. *When the slide is cold* it is treated with naphtha or any light paraffine oil, the solvent action being more rapid the lower the boiling point of the oil used.

Absolute alcohol is readily miscible with the naphtha or light paraffine, so that the solvent is readily removed. The slide can now be placed in successive alcohols, stained and returned to absolute alcohol. It is now to be cleared with creosote or oil of cloves and mounted in the ordinary way. Apart from the great advantage of being able to stain on the slide, this India rubber method seems to possess some points of superiority over the shellac method of Giesbrecht, *Zool. Anzeiger*, 1881. This depends on the fact that *sections can be mounted iu balsam direct from the naphtha.—Zool. Anzeiger, No. 140, p. 300, 1883.*

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SCIENTIFIC NEWS.

— Baron Nordenskjold's expedition to Greenland started last week in the *Sofia*, under the command of Captain Nilsson, and a crew of thirteen hands. Baron Nordenskjold is accompanied by Dr. Nathorst, geologist; Dr. Berlin, surgeon and botanist; Dr. Forsstrand, zoölogist; Dr. Hamberg, hydrographer; two Laplanders, two Norwegian ice-masters, one harpooner, and Herr Kolthoff as assistant zoölogist, with Herr Kjellström as typographer and photographer. The *Sofia* carries provisions sufficient for a sojourn of fourteen months on the inland ice, assuming that the interior of Greenland is covered by ice. The *Sofia* had as passengers to Iceland Count Stromfeldt, Dr. Arpi, and Herr Flink, who intend staying in the island for some time for the purposes of study and collecting.

— M. Fredericq, of Liege, says the *English Mechanic*, lately put several aquatic coleoptera (including the great water beetle) in aqueous solutions of curare and strychnine in poisonous quantity. A few drops of these liquors sufficed to poison a frog in a few minutes. The insects, however, lived in them, some more than a fortnight, others nearly a month (when the experiment was concluded). These Coleoptera are certainly sensible to the action of curare and strychnine, and the absence of symptoms of poison-

ing in the present case must be (the author says) because the absorption by the surface of the body and the mouth was *nil.* M. Plateau has previously observed that aquatic Coleoptera kept in sea water do not absorb its salts.

— The first Walker prize for 1883 was awarded to Howard Ayres, of Harvard University, for an essay on the embryology of *Œcanthus niveus*, the tree cricket. It will be seen in our advertising pages that besides the regular Walker prize, the Boston Society of Natural History, through the generosity of a member, also offers a first prize of from $60 to $100 and a second prize of $50 on the following subject: A study of the venation of the hind wings of Coleoptera, with illustrations of all the families of Le Conte's and Horn's classification.

— Dr. C. C. Abbott, of Trenton, N. J, has destroyed another old belief in weather lore. For twenty years he has kept a record of the building of their winter houses by the muskrats, the storing of nuts by squirrels, and other habits of the mammals which are commonly regarded as indicating the character of the coming winter. His conclusion is that the habits referred to have no connection with the rigor or mildness of the approaching season.

— It is stated that five perfect human fossils have been discovered in a cavern at the mines of Bully-Grenay, in the north of France. Weapons and utensils of stone and wood were found along with them. The remains have been taken to the towns of Lens and Lille, and invitations sent to the Academy of Sciences and the British Museum soliciting the attendance of some experts.

— The Balfour memorial fund will probably yield an annual income of £300, which it has been agreed shall be applied in endowing a studentship of original research in biology, and in making occasional grants of money in aid of similar investigations, especially in animal morphology.

— By a slip of the pen Professor W. W. Bailey said *circumference*, when he meant *diameter*, in his note on the big spider-web in Franconia. According to Mr. Emerton it was probably that of *Epeira angulata*, which he has seen two feet across.

— Adrian Luis Jean Francisco Sumichrast, an able naturalist and collector, well known to the scientific world, died on the 26th of September, 1882, after a short illness, and in the fifty-fourth year of his age, at Tonala (Chiapas), Mexico.

Professor Sumichrast, although for thirty years a resident of Mexico, to the study of whose natural history and antiquities he devoted much of his attention, was an European by birth, having been born on the 15th of October, 1828, at Ivorne (Canton du Vaud), Switzerland. He was a member of the Société des Sciences Naturelles du Canton du Vaud, of La Sociedad Mexicana

de Geografia y Estadistica, of the Société Zoölogique de France, of the Entomological Society of Philadelphia, etc., and a valued and active correspondent of the Smithsonian Institution, of the Cambridge Museum of Comparative Zoölogy, and of several other noted scientific institutions.

— Gen. Sir Edward Sabine, K.C.B., F.R.S., and president of the Royal Society of London, died in June. Besides his activity as member of various scientific societies, he will be remembered for his studies of the phenomena of terrestrial magnetism, first undertaken while attached to the Arctic expeditions of Ross and Parry. His other papers on physical science were also numerous.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Feb. 29.— Miss Lewis spoke of the structure of the barbs of birds' feathers. The portions that are lustrous are composed of angular cells, while the duller parts are formed of globular cells. Professor Cope, while making certain corrections in statements made by Professor Peters, called the attention of the academy to an interesting species of snake from South America, described by the latter naturalist. This species would have to be placed very near to the African genus Causus, proving that the Causus group, which has fissured fangs, and must be placed among the higher serpents, exist in the new world. Dr. Leidy stated that by careful calculation he had estimated that a female anodonta contained 1,200,000 eggs.

March 8.—Professor Cope gave an account of the Permian reptilian fauna, and described a saurian intermediate between types before identified from that formation under the name of *Chilonyx rapidens*. The reptiles of this epoch all belong to the Theromorpha, and have no affinity to those of Mesozoic times. The batrachia and reptilia also resemble each other more closely than do those of other periods, and both resemble mammals in certain parts of their structure, so that the points of departure of all forms of vertebrate life above fishes appear to exist in the Permian. Professor Heilprin again insisted upon the impossibility of the polar-ice cap attaining any such thickness as some have attributed to it, and observed that if the principles he had enunciated were true, they would apply also to Alpine and other summits, which must rise above the line of greatest precipitation. He cited numerous facts from various observers to prove that such lofty summits have, in fact, a much thinner covering of snow than more moderate elevations, and are in some cases entirely bare. Such an Arctic glacier as was postulated by some would require 25,000 years to move from 65° N. lat. to its terminal moraine, even if it moved at the rate of one foot per day. With the infinitesimal slope it would have, two and a half inches would be a more prob-

able rate of daily flow. Professor H. C. Lewis argued that conditions different from the present existed in glacial times. For example, the facts observed indicated a depression south of the glaciated area in the Delaware valley and elsewhere, producing a greater water surface. Errors often arose from want of attention to the relative elevation of glacial striæ. Striæ upon the high levels indicate the general movement of the ice, while those upon the low levels show the local movements of the lower strata. Professor Cope argued that the evidence was against a polar-ice cap of sufficient thickness to give the glacial ice the necessary motion; but that there had been rather an ice ring south of the Arctic circle, which would account for the glacial phenomena.

March 15.—Professor Cope described various Permian reptiles. Professor Lewis spoke of his discovery, in deweylite, of crystals which the blow pipe and other tests proved to be serpentine. The mineral contained also partially altered feldspar, and small, sharp fragments of quartz. The micaceous serpentine was the result of the alteration of the mica, but, being crystallized, was not a true pseudomorph. The occurrence of serpentine in crystallized slate, and the direct alteration of graphic granite into a magnesian mineral were the points he wished to record.

March 22.—Miss Lewis exhibited drawings of the structure of feathers in various genera of birds, and showed that the cell characters might be utilized in classification. Professor Koenig stated that recent experiments with a weak solution of gold containing arsenic acid had convinced him that the compound known as purple of Cassius was not a chemical compound. Professor Cope said that upon the evidence of fossils received from Professor O. Darby he had confirmed the determination of the existence of Permian strata in Brazil.

March 29.—Dr. H. Allen called attention to individual variation, and showed that parts related to each other varied together. For example, whenever the lower jaw is malformed the malleus, which in its development is the proximal part of the same series with the lower jaw, has been found in many cases examined to be malformed also. Two idiot skulls were exhibited to show the retention of juvenile characters. It was shown that in senility atrophy of certain portions of the skull occurred, and that this atrophy always affected parts that are last acquired by the race, and are absent in lower animals, as, for example, the orbito-temporal septum. Occasionally parts normally lost by man reappear in senile skulls, such as the paroccipital process.

New York Academy of Sciences, June 4.—The following papers were read: Evidences of former glaciation on western mountain ranges, and their bearing on the question of an ice-period, by Professor John S. Newberry. Mr. George F. Kunz exhibited some interesting and remarkable minerals.